The Welding Engineer

Edited by L. B. Mackenzie

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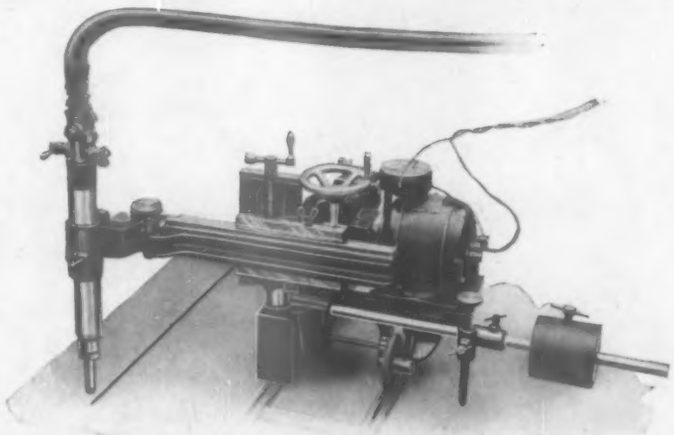

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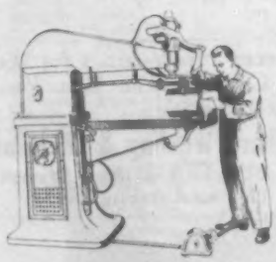

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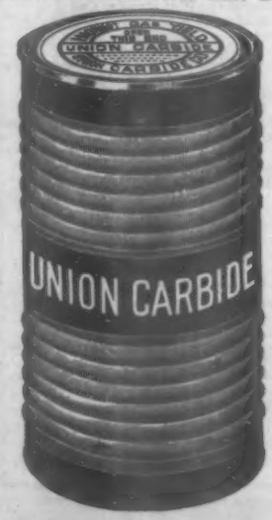

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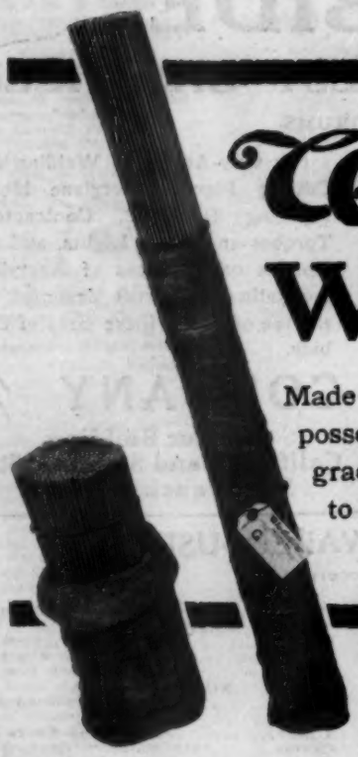

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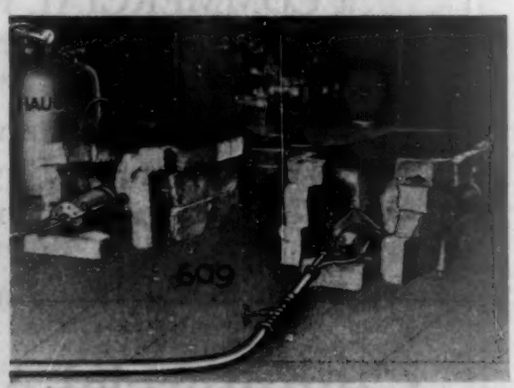

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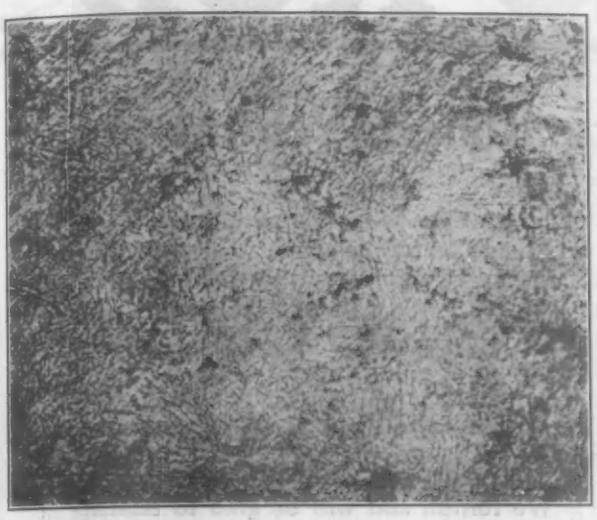

Photomicrograph showing slagless electric weld made with Page-Armco Welding Rods.

Photomicrograph showing slagless gas weld made with Page-Armco Welding Rods.

A weld free from slag or non-metallic inclusions is one assurance of a solid homogeneous deposit and therefore a **dependable** weld.

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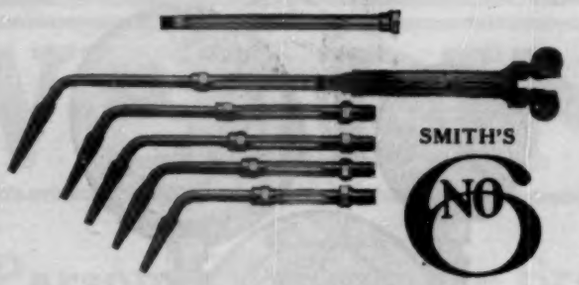

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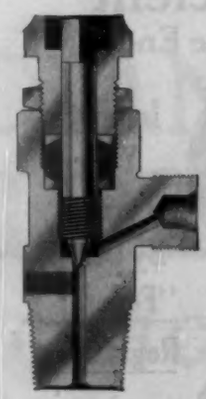

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0000

WELDING REPAIRS ON FROGS

Welding Shops Should Be Conveniently Located and Records of Costs and Savings Should Be Kept

By C. J. Mackie†

IT is highly profitable to reclaim rigid track frogs for further service by building up the worn surfaces with the oxy-acetylene welding process. This is likewise true of railroad crossings and switch points, but in this article we will consider in detail the reclamation of rigid track frogs only.

If frogs are to be successfully welded, they must not be left in track too long, but welded before the wing rails are cut to pieces and points of frogs broken down. Frog bolts must be kept tightened and broken bolts promptly replaced during the time the frog is in service. Otherwise, the frog will work loose pounding out the filler and ruining the point rail, making the frog unfit to reclaim and ready to scrap. The importance of keeping frog bolts in place and properly tightened cannot be emphasized too strongly.

Where traffic is infrequent or can be diverted temporarily, it is profitable to weld frogs in the track, but ordinarily better work can be done by welding the frog out of track.

These frogs placed in October, 1919. New frog on left and welded frog on right.

The expense of removing frog from track and installing a new frog is equaled or exceeded by the expense of taking gas and other materials from the welding shop to location of frog in track; welder going back and forth; flagman to protect welder; delays caused by passing trains and engines; and in addition to these the expense of inferior work done under traffic as compared with work done at a properly equipped welding shop.

Welding Shops Should Be Conveniently Located

Frog welding shops should be located at selected points to serve a designated territory. They should always be located at a terminal, permitting prompt handling of frogs in the terminal yard; frogs from outlying points to be shipped to the welding point for that territory. The welding shop should be located in a readily accessible spot in the yards so that there will be no delays or extra switching in setting cars for loading or unloading. These shops should be equipped with a simple one-man hoist and so arranged to permit one man to load or unload frogs and move frogs into and out of storage. It is entirely wrong to have an arrangement that makes it necessary to send a gang of section men to the welding shop to load, unload or move frogs.

As frogs for welding are received, careful inspection should be made to determine that they are worth reclaiming. Welders should be required to make report of all frogs received with missing or loose bolts and of frogs left in track too long. These cases can then be brought to the attention of the proper officers for correction. To permit an accurate record of frogs received, every frog sent in should be stencilled with the number and location of section from which it is released.

Preliminary to actual welding of frogs, missing bolts should be replaced, and all bolts carefuly tightened. After this has been done, the worn parts are ready to be built up with the oxy-acetylene welding process, restoring the frog as nearly as possible to its condition when new.

Records of Cost and Savings Should Be Kept

In order to know that it pays to reclaim frogs by welding, it is essential that an accurate record be kept of cost of reclaiming each frog, and of service obtained from reclaimed frogs when placed in track. The following table shows the record of cost of reclamation. The welder should fill in the data covering time, quantity of gas, welding rods, bolts and other materials used, and the cost calculations then made by the accountant. While it is not practicable to make a comparative service test of every welded frog, yet frogs from the various welding shops should be constantly tested in track against new frogs installed at the same time and under similar traffic conditions. These tests should cover the various phases of traffic conditions to which frogs are subjected.

New frog on left. Right one welded. The old will last as long as the new.

Burlington Test Covering Three Years

The Burlington Railroad, under the supervision of the general storekeeper, has been reclaiming rigid frogs for three years and we are of the opinion that properly welded frogs will give equally as good service and as long service as new frogs. October 10, 1919, we installed in a track serving one of our busiest passenger yards, a No. 9 85-lb welded frog and a No. 9 85-lb. new frog, traffic conditions being identical. Both frogs are still in service, but the welded frog is in somewhat better condition than the new frog. November 10, 1921, we installed in east end of one heaviest eastward main line leads, where heavy tonnage trains are started with difficulty, a No. 9 100-lb. welded frog and a No. 9 100-lb. new frog, the traffic over the welded frog being rather more severe than over the new frog. Both of trese frogs are still in service and both show evidence of considerable wear, but the welded frog is in fully as good condition as the new frog and will remain in track as long as the new frog.

The table showing the cost report covers the No. 9 100-lb. frog in service test just described, from which it may be seen that an otherwise scrap frog was reclaimed at an ex-

†*Storekeeper, C. B. & Q. R. R.*

penditure of $39.19, and that this expenditure made it possible to avoid the purchase of a new frog at a cost of $93.07, with a resultant saving of $53.88, or 137 per cent on the money expended.

Welder's Daily Report

Date of Report: Aug. 13, 1921.

Location: Burlington Railroad.

Operation: Applying new frog bolts, tightening all bolts and building up worn surfaces with oxy-acetylene process on one No. 9 100-lb. rigid frog.

Date and time commenced: 7 A. M., August 12, 1921.

Date and time completed: 1:30 P. M., August 13, 1921.

Hours welding: 11½ hours. Size welding head: Nos. 10 and 12.

Hours cutting: None. Size cutting head: None.

Hours preparation time: 1 hour, welder; 5 hours, laborer.

TOTAL HOURS: 12½ hours, welder; 5 hours, laborer.

Remarks: Laborer replaced broken bolts and tightened loose bolts.

OPERATOR: William Beckett.

New Value of Material Reclaimed, each	$93.07
Oxygen used: 456 cu. ft. at $1.75 Hd. cu. ft.	7.98
Acy. used: 445 cu. ft. at $280 Hd. cu. ft.	12.46
Filling rods:	
Size and No.; No. 2—¼ in.; Lbs.; 3⅛, at $17.60 cwt.	$ 0.55
Bolts used:	
No. 1, size 1⅛x10 in., at $57.82 Hd.	$0.58
No. 1, size 1⅛x12 in., at 67.18 Hd.	.67
No. 2, size 1⅛x13 in., at 68.86 Hd.	1.38
No. 2, size 1⅛x14 in., at 72.86 Hd.	1.46
No. 1, size 1⅛x15 in., at 54.53 Hd.	.55
No. 1, size ⅞x 7 in., at 14.02 Hd.	.14
No. 1, size ⅞x 8 in., at 15.24 Hd.	.15
No. 1, size ⅞x 9 in., at 15.78 Hd.	.16
Total	$ 5.09
Hours Labor: 12½ hrs., at $0.82 hr.; 5 hrs. at $0.49 hr.	12.70
Total labor and material	$39.19
Net saving by reclamation	53.88

—Railway Purchases and Stores.

THE MEANING OF IRON AND STEEL

By J. B. Green*

Much confusion has existed regarding the exact meaning of the terms iron and steel as applied to welding rod. This is not altogether the welder's fault, but rather a confusion which the welding industry has inherited. The difficulty comes from the fact that the words iron and steel have different meanings in different branches of the industry and still different to the chemist or metallurgist. The man who is not engaged in any of these industries but who has to use iron and steel is sure to be confused.

To the chemist, iron is a chemical element and this man considers steel as a commercial term in which he is not interested. He has evidently had trouble in making others understand that when he speaks of iron he means strictly a chemical element so he gives it the Latin name "Ferrum" and the chemical symbol Fe. The metallurgist deals less with theoretically pure chemical elements and more with elements which are practically pure. He prefers to call practically pure iron, "Ferrite." The Latin name Ferrum is almost never used except in its symbol form Fe for writing chemical formulae. The word Ferrite is becoming more common every day. We see it in our trade papers which are supposed to be read by welders and others not necessarily trained in the pure sciences.

Metallic iron might be said to be non-existant in nature. As we use it, it must be smelted from iron ore, which the chemist calls iron oxide. The metal coming from the smelter or blast furnace contains considerable quantities of carbon and other elements besides chemical iron. It is brittle and can not be used except for castings. Before the invention of such furnaces as are now used for refining this metal it was put in what is called a Puddling Furnace. In this furnace, the metal was heated to a pasty condition just below the melting point, and rolled around on a cinder bed until the carbon and some of the other impurities were burned out. The metal lost its brittleness and could be wrought. The metal coming from the blast furnace was and is for that matter, called pig iron on account of the way it was cast. That coming from the Puddling Furnace was called wrought iron because it was malleable and always wrought into bars, plates, etc. Such wrought iron is still made today in a very limited way, but it does not satisfy many of our present industrial requirements. By the nature of the process, it can never be uniform. Cinder or slag always gets mixed with it and about its only claim is an appeal to such people as feel the "good old days" were always the best.

We often see them paying a higher price for inferior stuff if it is only similar to what they used to get. In other words, the so called superiority of puddled iron is only a fancy in some men's minds so far as practically all of the uses to which ferrous metals are put today.

Sir Henry Bessemer was the first man to start the puddling furnace to the discard. He invented the Bessemer converter in which he could convert pig iron into malleable metal. This converter or furnace turned out a uniform product quickly, cheaply and without much manual labor. Later came the open hearth furnace and others for doing the same thing. While there is a difference between the product of the Bessemer and open hearth furnaces, still the product of either is so far superior to that of the puddling furnace that it became necessary to use a different term to describe it. Steel has been the common name for many years and we speak of refining pig iron into steel in the open hearth furnace. When such steel is wrought into bars, plates, welding rod and the like, it is perfectly proper to call it wrought iron or wrought steel. The man who looks at things more with the eye of a scientist would probably say wrought iron, because the material is from the chemist's standpoint commercially pure iron. The man who thinks essentially in terms of industry would prefer to say wrought steel because, when he says iron, one of two thoughts comes to his mind. Either he thinks of puddled iron, which he knows is an inferior product, or of pig iron, which is impure metal from which steel is made. In either case, the word steel represents high quality to him.

The welder who uses drawn welding rods would quickly reject rods made from puddled iron if he actually got some of this extremely rare material today. The only rods he is willing or ought to use are made by the steel making process. There is naturally a big difference in the grades of material made by this process, some being more and some less suitable to welding. It is perfectly proper to call such rods either iron or steel, but these names signify nothing relatively as to quality. The idea some welders have of keeping a stock of steel rod for one purpose and wrought iron for another is evidence of their ignorance of what these terms mean. The thing for the welder to do is to forget that iron and steel are different because, so far as he is concerned, they mean exactly the same.

If he finds one rod more suitable for a certain purpose than another, call it by its trade name or the name of the manufacturer.

*Welding Wire Department, Chicago Steel & Wire Co.

USE AND CARE OF REGULATORS

Importance of Good Regulator Action in Securing Proper Welding Flame — How Minor Repairs Can Be Made in the Shop

By Lorn Campbell, Jr.*

IN the past ,manufacturers of apparatus have laid a great deal of stress upon the various points relative to their torches. The gases being mixed in a certain part of the torch or under different conditions would produce flames which could not fluctuate. The torch tips had to be cleaned certain ways; special wrenches were provided and no limit appeared for the cautioning of the user as far as the torch was concerned. If a competitive torch was discovered with the flame varying ever so slightly there was but one means for overcoming this trouble; the purchase of a new torch. Why are such claims made? Each producer surely knows that there is little or nothing about the average torch that will cause the flame to change. The adjusting valves, once set, remain constant and pass the same volume of gas, the mixture of the gases continues unchanged and, barring the slight deviation which may occur when the torch is first warmed up, there is nothing about the average torch which can alter the flame in any degree.

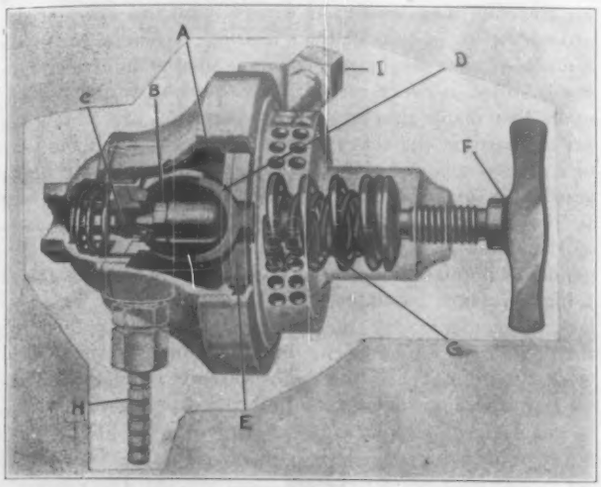

Fig. 1. A Phantom View of a Widely Used Regulator Wherein (A) Represents the Chamber; (B) the Nozzle; (C) the Seat; (D) the Yoke Connecting Seat to Diaphragm; (E) the Diaphragm; (F) the Cross Bar or Adjusting Screw; (G) the Diaphragm Springs; (I) the Inlet and (H) the Outlet for the Gases.

What then is the cause of this trouble which has bothered so many of the welders and cutters? It is not necessary to look far, for if the torch itself is eliminated, there remains but the hose and the regulators. Many times the hose is at fault. Small pin holes develop which open and close as the torch is manipulated, causing a slight change in pressure. More often this goes unnoticed in the oxygen hose than in the acetylene because in its escape it does not ignite or give off a pungent odor. However, while some of the trouble may be attributed to the hose, the major portion can be traced directly to the regulators. When analyzed, it is not at all strange to find in the regulators the cause of most fluctuations. Can not the regulators be likened to dams in large rivers; holding back immense pressures and permitting only a little of the water to continue on its way? The regulators bear the brunt of the burden; are more abused and more delicately constructed than any other part of the apparatus. It is a wonder that they stand up as well as they do. The abuse is not intentional on the part of the operators but is due mostly to lack of knowledge as to the functioning. If a welder once is told or is shown just how a regulator works internally; how to use it and how not to use it, the chances are he will have no further trouble.

Sales Engineer, U. S. Welding Co.

In order to understand the care and repair of regulators it is quite essential that the fundamentals, upon which they operate, be thoroughly understood. If an ordinary needle valve is taken for an example and placed on a tank containing gas under high pressure it might be possible to manipulate it in such a manner that only a small amount of gas would be allowed to pass and a welding flame could be maintained. Under such conditions the valves on the torch could not be used, for any closing off would cause the pressure to increase in the hose and either blow it off its connections or burst it. In a properly working regulator the original pressure is not only reduced to any degree desired but the reduced gas is at all times under complete control. By this is meant, the pressure of the reduced gas can be raised or lowered at the will of the operator and very accurately adjusted to any fraction of a pound; not only this but when the torch valves are closed the regulator automatically shuts off further flow from the source.

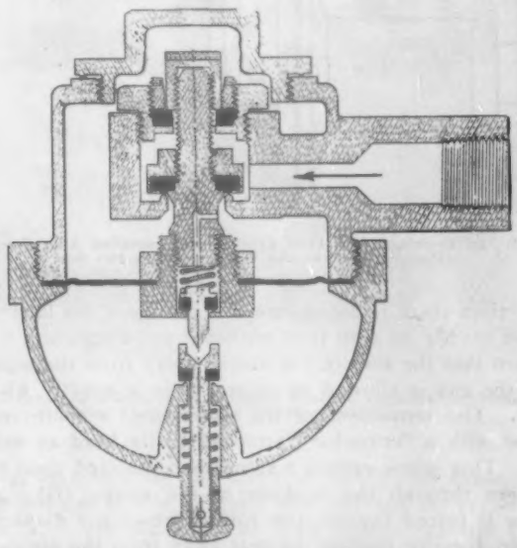

Fig. 2. A Pneumatic Automatic Type of Regulator. It Will be Noticed That the Diaphragm Springs Have Given Way to an Air Tight Chamber with Means for Admitting and Exhausting Gas Under Pressure.

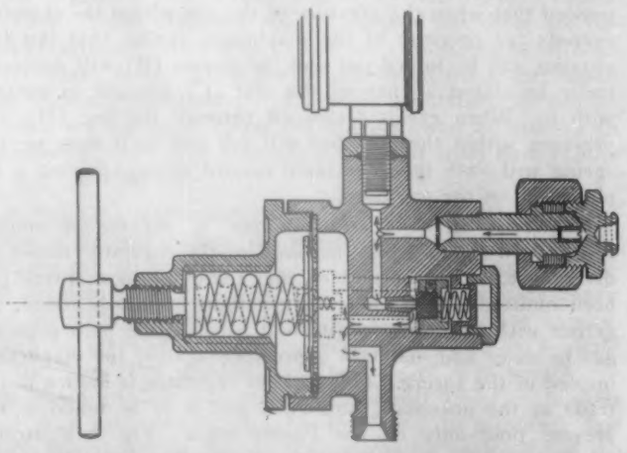

Fig. 3. In This Regulator the Yoke is not Secured to the Diaphragm. The Spring Tension Behind the Seat is Depended Upon to Shut Off the Incoming Gas When the Pressure Within the Regulator Has Reached a Point Equal to That Exerted by the Diaphragm.

Regulators control the pressure by means of a diaphragm. The arrangement shown in Fig. 1 illustrates the relationship between the diaphragm and the rest of the parts. It should not be difficult to trace the path of the gas as it comes from the tank under high pressure and enters the regulator through (I). In order to reach the chamber or reservoir (A) the gas must first pass through the nozzle (B). In so doing it comes in contact with the seat (C) which is attached to a yoke (D). (D) in turn is attached to the diaphragm (E) and is moved

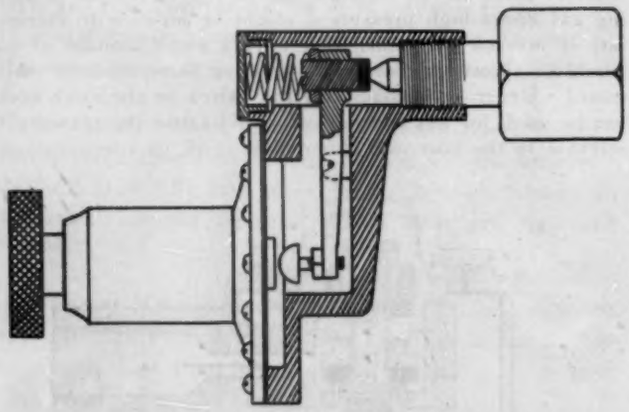

Fig. 4. In Regulators of This Type, a Fulcrumated Arm Conveys the Movement from the Diaphragm to the Seat.

each time there is a pressure exerted upon the latter. Now it can readily be seen that whenever the diaphragm is forced inward that the seat (C) is moved away from the nozzle (B) and the gas is allowed to enter. This is exactly what happens. The movement of the diaphragm is controlled by a screw with a "cross-bar" attached to its head as shown by (F). This screw causes a force to be exerted upon the diaphragm through the medium of the spring (G). As this screw is forced inward, the spring causes the diaphragm to recede, thereby moving the seat away from the nozzle. It is evident that the gas, entering the chamber (A) under high pressure through (B), will communicate an equal force on all parts of the chamber. The diaphragm will naturally receive its share. Now the walls of the chamber, being made of cast metal, are not free to move, consequently the pressure of the gas has no effect upon them. The diaphragm, however, is designed purposely to respond to such pressure so it will be noticed that when the pressure of the gas within the chamber exceeds the pressure of the diaphragm spring, that the diaphragm will be forced out and the nozzle (B) will automatically be closed by having the seat (C) brought in contact with it. When gas is drawn off through the line (H), the pressure within the chamber will fall and as it does so, the spring will push the diaphragm inward again, allowing a replacement of the gas used.

Numerous methods are employed to accomplish similar results. In Fig. 2 while the body of the regulator shows no divergence, it will be noticed that the diaphragm spring has been omitted. In its place a gas tight bonnet is found, together with means for permitting some of the high pressure gas to enter and maintain a pressure against the diaphragm instead of the spring. This style of regulator is known to the trade as the pneumatic automatic and is to be found at the present time only on the Pacific coast. Fig. 3 illustrates another variation which is quite generally used. The principal difference between it and the one shown in Fig. 1 can be seen in the seating control. In place of having the seat connected to the diaphragm, the tension of a spring within the chamber itself is relied upon to close the seat when the diaphragm is in its normal position. In Fig. 4 the same general scheme as in Fig. 3 is found, the only difference being that a fulcrumated arm is used to close the seat. Regulators of this style are very popular in Europe but few are to be found in this country. Fig. 5 sets forth a slightly different seating arrangement. In those previously shown the seats all closed against the incoming pressure. In this regulator the seat is designed to close with the incoming pressure.

The regulators here illustrated are used only to set forth different means for the control of gas under pressure. It goes without saying that the styles offered to the trade are numerous and varied. The outward appearance may be changed but taken as a whole all regulators in common use employ one of the five principles just described.

There are two types of regulators manufactured for the reduction of gases under high pressure, depending upon the nature of work to be done. The high-pressure regulator is employed for heavy work where a great deal of gas is used and the regulator must pass it without much effort, to prevent its freezing. This type of regulator is used on cutting or on large welding work. It differs from the low-pressure or ordinary type in four distinct features. Generally it contains a much heavier diaphragm which is smaller in diameter, making it stiffer in every respect. The tension springs which act upon this diaphragm are much heavier. The nozzle which presses against the seat is much larger, to permit the passage of a greater amount of gas. Then, too, a larger working pressure gauge must be used, in order to read this high pressure. In the welding of metals, especially in steel, the adjustment of the flame is a very important matter, and absolutely dependable regulation must be had. This is not possible with a high-pressure regulator and is not intended to be so. The larger the diaphragm, the more sensitive the regulator, and this point should be borne in mind, and no small welding work attempted with the high-pressure regulator. The reverse form of reasoning may be applied to low-pressure regu-

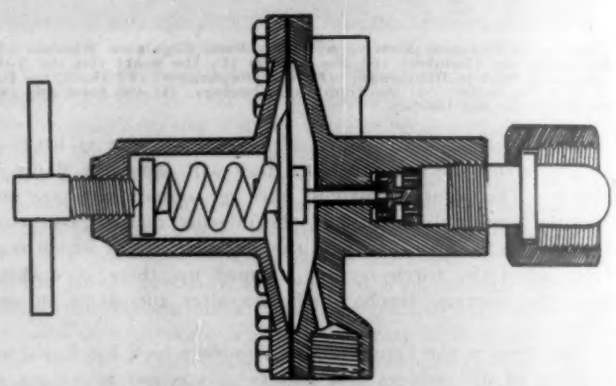

Fig. 5. A Regulator in Which the Seat is Arranged to Close With the Incoming Pressure and not Against it as is the Case in Most Regulators.

lators which have been used in cutting. They are very likely to be strained and satisfactory results cannot be expected, for they are not made for that purpose. Acetylene regulators are constructed much more sensitively than the oxygen regulators, to take care of the lower pressure of gas and in a sense might be called weaker, insomuch that the larger nozzle which passes the gas is closed or regulated by springs which are not nearly as strong as in the oxygen regulator. For this reason acetylene regulators cannot be interchanged with oxygen regulators for they will not stand the pressure demanded in the first place, and in the second place, were a small quantity of acetylene gas left in the regulator and oxygen introduced, an inflammable mixture would be formed which is not advisable to have present, on account of its explosiveness. In many instances oxygen regulators are put out with copper or bronze diaphragms, whereas another metal must be used on the acetylene regulators, because acetylene gas attacks copper. Usually a German silver or rubber dia-

phragm is used. On account of the lower pressures used in charging the acetylene cylinders, lower pressure gauges are used than on oxygen regulators.

Before taking up the operation and repair features it might be well to mention why the high-pressure gauge on the acetylene regulators tend to deceive some operators. In acetylene cylinders an absorbent called acetone is generally used, which gives up the gas as required. A full cylinder can be used for some time without any noticeable difference in the gauge reading, and then, as it nears the empty point, the gauge reading will drop very perceptibly. It is therefore impossible to depend upon a high-pressure acetylene gauge as an index to the contents of the cylinder. The only method

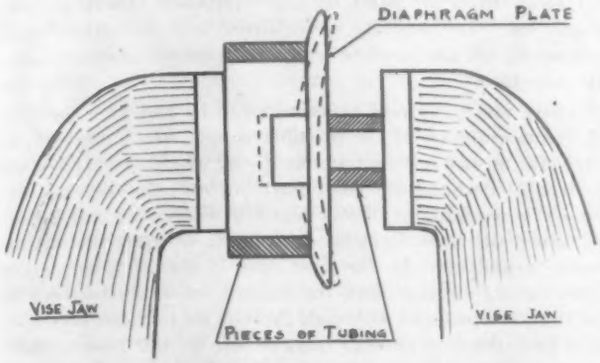

Fig. 6. A Very Simple Method Used to Form a Diaphragm Plate to Overcome Certain Ailments.

known to correctly check the amount of acetylene gas on hand is to weigh the cylinder. There are 14½ cubic feet of acetylene gas to the pound, and when the net weight of the cylinder is given the contents can readily be figured. A tag bearing the net weight or figures which will permit its computation is generally found attached to each acetylene cylinder. In the case of oxygen cylinders, there being no absorbent used, the contents of the cylinder is indicated on the high-pressure gauge. On the latest type gauge the contents will be shown by cubic feet, by pounds pressure and by atmospheric pressure, to facilitate the computation of costs by the operator.

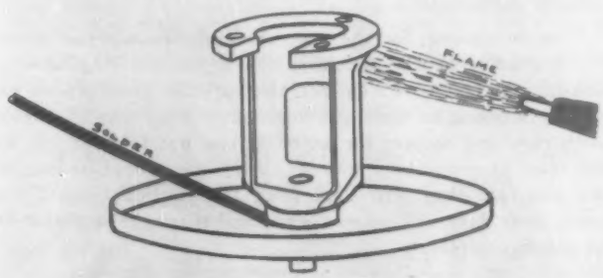

Fig. 7. Illustrating Just How the Yoke is Heated, When Soldering to the Diaphragm to Prevent Diaphragm from Becoming Annealed.

As indicated earlier in this article, a regulator is a very delicate apparatus and should be subjected to as little abuse as possible. Sudden pressures under certain conditions and the presence of metal filings or dirt are the things to guard against. The seat and diaphragm are the parts that suffer as will be shown shortly. The correct procedure in connecting any regulator is as follows: Before attaching the regulator to the tank, the tank valve should be "cracked," i. e. opened and closed quickly to blow out any dirt or foreign particles that may be lodged there; otherwise, they will be carried into the regulator seat and cause "creeping" or may close up some small passage along the line, which will impair the working of the apparatus. After connecting the regulator, all tension should be removed from the diaphragn springs by screwing out on the "cross-bar" (that is to the left), before turning on the gas. If a matter of 2,000 pounds pressure were admitted suddenly into any regulator that had the seat removed from the nozzle, there would be a sudden exertion upon the diaphragm, which would draw the regulator seat up very violently against the nozzle. If this action were not too great it might only crack the seat or perhaps groove it to such an extent that it would leak and a trouble known as "creeping regulator" would result. However, if the action were forceful enough, not only would the seat be injured but the diaphragm would be ruptured as well. If this occurs, good work cannot be expected because the flame will not remain steady and it is,

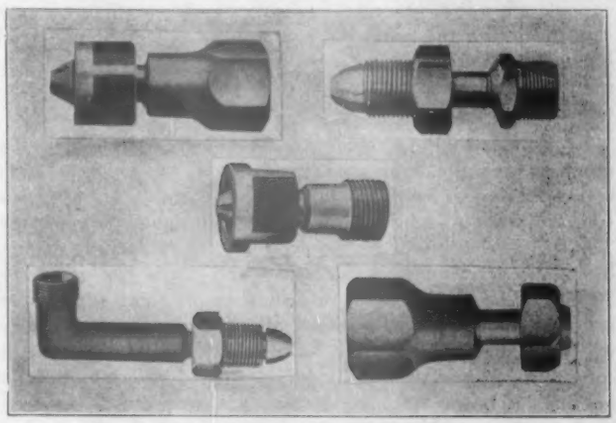

Fig. 8. Regulator Adaptors or Fittings Used to Connect Regulators to Gas Tanks Having Different Fittings.

therefore, necessary to take steps to rectify this abuse. Assuming that the seat is the only part affected the repair will be quite a simple matter. The back of the regulator is removed and after screwing in on the "cross-bar," to remove the seat from the nozzle, the seat should be removed. In many regulators means are furnished so that a seat may be dressed off and then screwed back into position. In others the seat is loose and if one side becomes grooved or pitted it can be turned over and the other side used. Should the seat be cracked, then a new one must be procured. Seats are made of gallilith (compressed sour milk) casinite, hard rubber or fiber. There are other substances used but these are the most common. There is no excuse for a welder to be without a few extra seats. They can be purchased for a very small cost from any manufacturer of welding apparatus. Of course, if none are on hand, about the quickest way of making an emergency repair is to turn out a new seat from hard rubber or fiber on a lathe.

Perhaps the diaphragm is only slightly affected. If it is of rubber a piece of packing can usually be found and a new diaphragm cut out very quickly. Should it be of metal a different problem presents itself. Very often a temporary repair can be made by simply removing the spring plate casting, which is screwed against the diaphragm; give it a slight "belly" and then replace it. The "belly" will stretch the diaphragm slightly and remove any small kinks or buckles that may have developed. An easy way to introduce this "belly" is shown in Fig. 6. The pieces on each side of the plate and in contact with the vise jaws are made from different sized pieces of pipe. The dotted lines are very much exaggerated; the contour should not be more than one-sixteenth of an inch. When a metallic diaphragm cannot be repaired in this manner it is time for a new diaphragm.

There is quite a knack in assembling a new diaphragm where solder is required, without annealing it. The yoke is

first removed from the old diaphragm and mounted on the new. It is held in place by the spring plate while soldering. This is best accomplished as shown in Fig. 7. It will be noted that the flame is not brought near the diaphragm. On the contrary, it is kept as far away as possible. By playing the flame on the upper portion of the yoke casting, enough heat is conducted to the base to melt the solder. Just as soon as the solder runs, the diaphragm is immediately plunged into water. When cool it is ready for mounting on the body casting of the regulator. It should be pressed into place very carefully to avoid denting. If there is any difficulty encountered in holding it flat, the seat holder can be screwed in position temporarily from the back. The soldering should be done with a fairly heavy iron and the quicker the better, for the chance for annealing will be reduced. It is considered good practice to heat up the regulator casting slightly before the soldering commences as it helps materially in speeding up. As soon as the soldering is finished the regulator is cooled off and is then ready for assembling and testing.

In shops where welders are troubled with persons, not familiar with the apparatus, handling it, the chief attraction seems to always be the regulators. Invariably a curious person will want to see if the hands on the gauges are working. The "Cross-bar" will be screwed in and if nothing happens it will be screwed in still further and that's the way it will be left. The welder upon returning to his torch will remember that, as usual, he released all pressure on the regulator when leaving the outfit and will assume that it is still in that condition. When the tank valve is opened he learns different, but then it is too late, the damage has been done. One good way to prevent this tampering is to remove the "cross-bars" from the regulators when leaving the apparatus for any length of time. These serve as keys for locking the regulator and will insure them against injury from this source.

Some regulators have a habit of vibrating every time a certain pressure is reached. This is a very poor thing to let continue as the vibrations give a ramming effect to the seat and will tend to groove it. The cause of this trouble is the unbalanced condition of the regulator. There is a certain relationship exists between the diaphragm; the diaphragm spring; the chamber; the opening in the nozzle and the back tension spring, if one is used. Manufacturers as a whole appreciate the bearing each of these parts have on the other and design their regulators accordingly. As a rule most vibrating can be found in new regulators. Assuming that the size of the nozzle, the seat and the chamber remain the same as when last inspected by the manufacturer it is safe to say that the diaphragm or springs have become what might be called "seasoned." This may alter conditions very slightly but nevertheless enough to unbalance the regulator. To correct this, remove the bonnet and place a thin washer of fiber or cardboard under the diaphragm spring. This is usually all that is necessary to stop the vibrating. Should it continue, a new diaphragm is recommended.

Sometimes welders receive new regulators that leak. They naturally contend that it was shipped without being properly tested. All reputable manufacturers test their regulators, not once, but several times before shipping. Nevertheless the purchaser is many times justified in claiming that it leaked the first time it was used. What then has happened between the time it was tested and when it was placed in service? Most regulators have a cast body. Core sand or filings have been known to cling to the sides of the high pressure gas passage or lodge in some small nook and resist all attempts to remove with compressed air and rapping. They test all right and the inspectors pass them. In shipping they are given to the transportation company and the express or freight hands do what the compressed air failed to do; namely, they jar the sand loose. Therefore, the moment this particular regulator has the gas turned into it, the sand will be held in the seat and of course it leaks. To restore to its proper working condition, remove the seat; rap the body of the regulator gently with a hammer; then blow it out thoroughly; clean off the seat and reassemble.

"Use No Oil" is a slogan which can be found on all regulators and gauges. This is to be particularly emphasized where oxygen is used. The greatest danger is to be found where oxygen comes in contact with oil in a confined space. When burning out carbon from gasoline engines, oxygen is deliberately fed into an oily chamber and no particular harm develops but let a small particle of oil or grease be left on a regulator seat and immediately the oxygen strikes it a combustion takes place. For this reason it is always well to keep oil away from all parts of any equipment where oxygen is employed. In handling a regulator seat sometimes enough oil comes off the hand to cause it to ignite when the oxygen is turned on.

There are many odd experiences to be had with regulators. To enumerate all of the possible things which might happen and cite means for overcoming them would require a volume in itself. Perhaps the most puzzling may be the case where an oxygen regulator shows signs of life either just before it is turned on when lighting up a torch, or after the torch has been turned off. In the first case if the acetylene gas has been turned on and light, the oxygen valve on the torch may be slightly open and although there is no pressure on the oxygen line, there is enough oxygen left in the hose to form a combustible mixture with the acetylene that leaks in. A burning back to the oxygen regulator will result. Where the trouble takes place after the torch has been shut off, generally the same condition can be found. Either the oxygen valve on the torch leaks or it has been left open. As the flame is shut off it pops out. This pop sometimes is in the nature of a "flash-back" and carries the flame past the oxygen valve, into the oxygen hose. It is recognized that fire can not be maintained in confined places unless oxygen is present. An ideal condition presents itself here. As the fire enters the hose, the inner lining, which is for the most part of pure gum rubber, ignites and continues to burn due to the presence of the oxygen. Once started the fire follows the oxygen up the hose and then enters the regulator. These are rare cases. They are only mentioned to show why it is so important to keep all parts of the apparatus in first class condition and operate it correctly.

Now in closing, for the sake of emphasis, a phrase used at the beginning of this article is now repeated. Regulators are sensitive instruments. In fact, they are the most delicate part of any welding or cutting equipment. They must be treated with care and respect for an outfit can not function any better than its regulators permit. With the proper understanding and care they will serve long and faithfully but lacking such, their days will be numbered and they will be the subject of much complaint.

An exceptionally usable Foreign Commerce Handbook has just been issued by the Foreign Commerce Department of the Chamber of Commerce of the United States.

Within the space of 31 pages this publication condenses a mine of information as to sources of service in foreign trade. Its alphabetical arrangement makes it a handy reference work for the busy exporter or importer. The book contains also a list of the topics of national importance that are engaging the attention of the National Chamber's Foreign Commerce Department Committee under the chairmanship of Willis H. Booth of New York.

As the first publication of its kind the handbook meets a distinct need in foreign trade circles.

TESTS OF STRUCTURAL STEEL WELDS

How the Reliability of Welded Joints is Determined Together with Limiting Conditions of Various Types of Joints

By E. S. Humphrys, Jr.†

RAPID growth of the application of arc welding to structural parts has inspired the writer to carry on a series of tests which would tend to show what reliability could be attached to this method of construction. Naturally, one of the first questions was, "Why should the parts of a structure be electrically welded rather than riveted?" Analysis of this subject showed that great economies can be effected by the arc welding method and that, in addition, the necessary high quality of workmanship can as easily be obtained.

To visualize the tests as they were conducted, it may be stated that first consideration was given to the lay-out of a building, 40x40x40 ft. In this connection it was found that the amount of time consumed in the drafting room, and the drafting room costs, would be approximately the same for the structure whether welded or riveted. In designing structural parts, when they are to be riveted together, the size and position of rivet holes are shown; in designing a structure for welded joints, all such connections must be designated by shaded portions. Because at least two holes must be punched for each rivet, great saving is effected in the use of arc welded joints, where the cost of punching holes is almost entirely eliminated. Those familiar with this type of construction will appreciate that the cost of drifting enters also, to a greater or less extent, and the elmination of this variable expense is an additional argument in favor of arc welding methods.

Let us consider what would have been the cost of riveting the structure 40x40x40 ft., then let us compare, with the figure thus obtained, the actual cost of construction which was done by welding.

Structural steel used		39,334 lb.
Welding Costs:		
165 welding hours at (average) 55c	$ 90.75	
150 lb. welding wire at 10c	15.00	
		$105.75
Riveting Costs (estimated):		
Riveters, 78 hr. at $2.25	$175.50	
Rivets, 1800 at 1.235c	22.25	
		197.75

Notes:

Wages of four-man riveting gang: $2.25 per hr. per gang. Estimated, 4500 holes for 1800 rivets. On a structure of this type it is estimated that there would be driven no more than 200 rivets per day by one four-man gang.

In this comparison no mention has been made of the following items, some of all of which would enter into the final cost of the welding or riveting operation.

Riveting:

Cost of template; of prick punching holes; of punching holes, or of drilling and reaming them.

Percentage of rivets lost of those ordered.

Cost of fuel consumption in the rivet heater; of air per cu. ft.; of making a hammer test on all rivets.

Welding:

Cost of fuel, in this case electricity, figured at so much per kwh.; of sand blasting surfaces about to be welded, to free them from rust or scale, a practice sometimes followed.

Observations taken through the investigation show convincingly that at times fabrication can be conducted more easily and at greater convenience by using welding rather than riveting methods. Labor charges are reduced and time saved because no material need be handled twice; everything can be done in such a way that there is a minimum of lost motion.

More fully to appreciate what constitutes a proper manipulation of the arc, the writer enrolled in the arc welding school of the General Electric Co., Schenectady, there taking the practical course in welding. This enabled him to assist in supervising the welding of test pieces, in detecting any intentional carelessness on the part of the operator, and at the same time in securing a full appreciation of the labor involved in welding a structural joint similar to one which ordinarily would be riveted.

All the test data, which will be incorporated further along, relative to tensile strengths of various types and sizes of welds, were obtained in the testing laboratory at Union College, using for the purpose a 200,000-lb. tensile machine.

One important feature, which should be given consideration, is the relation between the total dead weight of a truss wholly welded and that of the same truss, riveted. A number of tests and computations have shown that a welded truss of the same strength is appreciably lighter. Is not this fact alone sufficient reason why executives who are interested in structural work should give careful attention to this fastgrowing and dependable method of construction?

The intention of this article is not to point out any definite or standard method of fastening together structural parts preparatory to welding, since in the majority of instances the local company—assuming that this work is carried on under

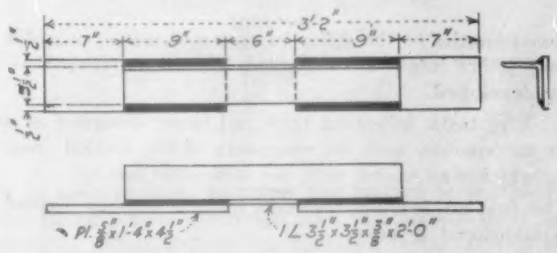

Fig. 1

a structural superintendent—will be in a much better position to recognize the most efficient ways of assembling jigs and clamps. For these reasons the endeavor has been to ascertain only the true value of a welded joint as compared to that of a similar joint, riveted.

An additional fact which should be mentioned before the test data are illustrated is this, that a welder and one helper together are capable of producing more work in a given time than that which could be turned out in the same time by a riveting gang, the latter consisting of from three to five men.

Before undertaking this investigation, the writer had been under the impression that in all past structurally welded members far more electrode material had been applied than was necessary to make the joint reliable, and one which would withstand safely the stress to which it was subjected. This impression was substantiated later, as the results of test showed.

The welded specimens were prepared at the General Electric Co., under the supervision of W. V. Lewis, structural supervisor, and welded by the departmental operator, W. Kutassy. The latter has been welding for the past ten months only, yet great dependence is placed on his efforts. I cite this fact, tht it may be realized that actual welding operations were carried on to give an average rather than a maximum value.

All structural members used in the tests were taken from stock, and no especial preparation of the surfaces to be welded was made other than the cleaning of those surfaces with a small wire brush. What scale and other surface impurities resisted the brush were allowed to remain. It is not

†Union College, Schenectady, N. Y.

meant to infer, however, that there should be no treatment of such surfaces; in fact, a small, portable sand blasting equipment is recommended, with which may be removed the tougher and more objectionable impurities.

The electrode or filling material used in joining the structural members was a standard, commercial, bare wire, the approximate analysis of which is as follows:

Carbon—low.
Manganese—high.
Sulphur—low.
Phosphorus—low.
Silicon—trace.

The tests may be divided into two groups:

1. Six preliminary tests, made to determine the approximate strengths of the different types of welds, in order that future joints might be designed with the strength of each fully developed.

2. Five tests, following these, all being designed as nearly alike as possible, with the exception of the welded cross section, which was varied with the individual test.

The first six preliminary tests may be further divided into two additional groups:

a. Joints composed of two plates and two angles, or of two plates and one angle.

b. Joints composed of four plates, as illustrated in the accompanying diagrams.

Description of the First Six Tests

One angle of dimensions shown in Fig. 1, was lap-welded in shear to two flat plates, one plate at each end of the angle. All welding areas or cross sections are indicated by shaded portions. This specimen was gripped in the tensile machine and pulled apart to determine the ultimate strength either of the welds, the plates or the angle. In advance of the test the prediction was made that the weld would go before either the plates or the angle.

At 89,230 lb. the ultimate strength was reached. With the exception of a few small cracks, the welds were unharmed. Fracture occurred in the angle on a line approximately perpendicular to the line of stress and was seen to be one of shear; in addition, the specimen bent in two directions, as would have been supposed. This gave no numerical indication of the weld strength in shear, save that it was greater than that of the angle.

The specimen in Fig. 2 was made up of four plates (two end plates and two cover plates) welded as before, in shear. Cover plates were used instead of one or of two cover angles because it had been observed in the preceding test that there was induced too much bending in the specimen to give accurate results.

Under stress, the two end plates elongated and became deformed, until the ultimate strength of the two cover plates was reached, at 158,420 lb., when the two later broke in shear, perpendicular to the line of pull. Again it had been graphically demonstrated that the plates were too weak for the welds.

A third test was made up similar to the one in Fig. 1, except that in this instance two angles instead of one were used to connect the end plates. As had been foreseen, there occurred bending in the specimen to an amount sufficient to be readily noticeable and, quite probably, to affect the results obtained. In this case the strength of the plates and angles proved to be too much for the combined strength of the welds, and the latter failed at 114,750 lb. It is thought that a greater pull could have been withstood had there been no bending stress induced. It was desired to obtain the strength of each weld per lineal inch, but, because of the bending moment, this calculation was not made.

Fig. 2

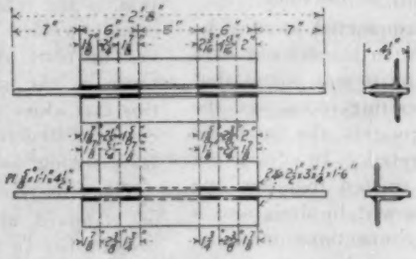

Fig. 3

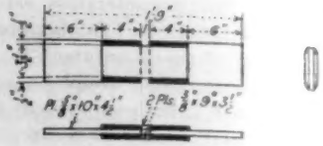

Fig. 4

In the fourth test, Fig. 4, two cover plates were welded, in shear, to two end plates, as in the second test. By using four plates welded together in this manner, the bending moment was reduced to a minimum, and the results obtained represent true values of shear. The breaking strength was 149,500 lb. Four of the eight welds broke almost simultaneously along a line parallel to the line of force and through their approximate centers. Calculations shown elsewhere give values per lineal inch of weld, and for shear per square inch of welded area on a plane parallel to the length of the weld.

There was no designed difference between the fifth specimen, Fig. 5, and the one immediately preceding it, except that shorter lengths of weld were deposited in the latter instance. This specimen broke as did the other, to give an ultimate strength of 116,320 lb. The lineal strength, therefore, was equal to 9,685 lb. per running inch of weld; that in the fourth test was 9,340 lb.

In this and in the last test the weld metal was deposited continuously in one solid bead; in test pieces of the second group, which are yet to be described, each welded volume was made up of two beads, a small one running along the line of intersection of the two welded surfaces, and a second one over the first and filling in to the required volume. For cross section of bead thus described, refer to Fig. 5-A.

Fig. 6 shows that this specimen was designed to be the same as Fig. 5, save that the length of material deposited was as nearly as possible one-third that laid down in Fig. 5. It was thought that this weld would not be one-third as strong as in Fig. 5, because of weaknesses at the beginning and at the ending of the beads, which would be more pronounced in this, the smaller weld, thereby causing it to break sooner. This was found not to be the case.

On the contrary, the smaller weld was slightly more than one-third as strong as the longer weld, which, perhaps, was accounted for by the fact that in the shorter weld there was deposited a slightly greater proportionate amount of electrode material than in the other. Further tests might prove that weld strength varies directly with the length of the weld. The ultimate strength of this specimen was 45,570 lb. Fractures occurred in the welds, parallel to the direction of stress.

It will have been noticed that, in the tests above described, little was given in regard to the computations for strength of welds. The main reason for making the tests was to determine an approximate value for strength in shear of each type of weld so that, in designing further specimens, there would not be deposited so large an amount of electrode metal that the plates, and not the welds, would fracture.

Description of Last Five Tests

These five tests are grouped together because of the longitudinal dimensions common to all. In Fig. 7 the dimensions shown are constant; those left blank vary with the type of specimen and may be found further along. Welding is indicated by the shaded portions.

In each of the five groups of tests about to be described

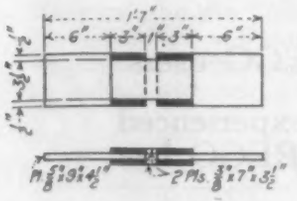

Fig. 5

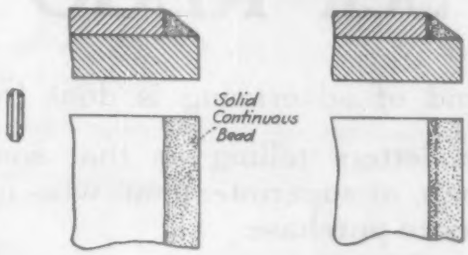

Fig. 6

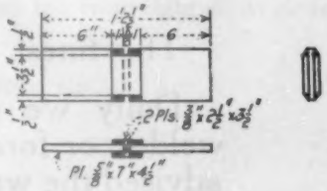

Fig. 7

there were broken four specimens, all four being designed alike, making a total of twenty individual fractures. From the data obtained calculations have been made and conclusions drawn. The twenty test pieces were welded under the following conditions, as nearly as possible alike:

Welded length, each specimen: Eight 3-in. welds; total, 2 ft.
Voltage: Open circuit, 60; arc, 20.
Steel: Structural, taken from stock
Electrode: Standard make, of composition given above, diameter, ⅛ in.
Size rivets: ⅞ in. used in calculations of relative strength of joint, welded or riveted.

All test pieces were of the same longitudinal dimensions but, to secure the desired cross sectional areas of beads, the thicknesses and widths of the various plates employed necessarily varied, information for which is given in Table I.

Table I—Specifications

(All dimensions in inches.)

Test No.	Bead "A"	Bead "B"	Plates No.	Plates Size
8	½	½	2	⅝ x 9 x 4
			2	½ x 6½ x 3
6	⅝	½	2	⅝ x 9 x 4½
			2	⅝ x 6½ x 3½
9	⅝	⅝	2	⅝ x 9 x 4¼
			2	⅝ x 6½ x 3½
10	¾	⅝	2	⅝ x 9 x 4¼
			2	¼ x 6½ x 3½
11	¾	¾	2	⅝ x 9 x 4
			2	¼ x 6½ x 3½

Throughout the course of the tests a careful measurement was taken of the amount of electrode material deposited and of the time required to weld each specimen. A glance at Table II will show that, as one would have expected, the amount of filling material increased as the cross sectional area of the bead was increased. This was not the case when the length of time taken to weld was observed; time did not vary directly, or even approximately, with the area of the bead.

To be of commercial value, the strength of any one of a

Table II—Welding Operations

Test No.	Arc Volts	Electrode Size, In.	Electrode Amount (Each Spec.) Lb.	Amperes	Time Total, Ft.	Time Rate (Lineal In. per Min.)
8	20	⅛	1.39	175	33.00	0.73
6	20	⅛	0.966	175	19.87	1.22
9	20	⅛	0.77	150	22.75	1.06
10	20	⅛	0.561	150	14.25	1.686
11	20	⅛	0.328	150	9.00	2.67

centage. Our experiments demonstrate that, in this type number of welded joints may not vary from their mean value by more than a small and fairly definitely known per- of joint, the variations in strength are small and compare favorably with joints riveted in the usual way. The widest deviations from the mean occurred in test No. 8, where the plates were heaviest and where, in consequence, the beads were of the greatest cross sectional area. In four of the five groups of tests no one variation exceeded 2.2 per cent of the mean value; in the fifth (Test No. 8), the largest variation was 5.79 per cent. From this we conclude that the welded union is not the changeable quantity which some might expect it to be, but is fully as dependable and as strong as any other common type of joint. Table III lists the variations as they were determined from tests made.

Table III—Strength Variations

Test No.	Ultimate Strength of Weld (Average, Lb.)	Largest Percentage Variation from Mean
8	142,500	—5.79
6	131,110	—1.22
9	120,000	—2.20
10	96,400	—1.73
11	89,650	1.88

It is interesting to compute the riveted strengths of the joints tested for weld strength and to compare these figures with those obtained from the breaking tests. It will be observed that these particular types of unions could not be riveted to give a strength equal to that of the same joints, welded. Only one rivet can be used in each section, and it cannot exceed a diameter of ⅞ in.

Table IV makes the following assumptions: Ultimate tensile strength of mild steel ordinarily used in structural work, 60,000 lb. per sq. in.; rivet strengths, in single shear, 45,000 lb. per sq. in.; bearing, 90,000 lb. per sq. in.

Our welds gave shearing values which varied, in intensity, inversely as the cross sectional area of the bead. In comparing the calculated shearing value of structural steel with the observed values of the welds, a unit shearing value of 45,000 lb. per sq. in. was assumed as the ultimate shearing strength of the steel. Table V gives the shear for the five groups: it varies from 33,650 lb. per sq. in. in the weld of largest sections to 42,900 lb. per sq. in. in the smallest, indicating that, in some respects, a small weld is more economical of strength than a large weld. Based on the value of

Table IV—Comparative Strengths

Test No.	Calculated for Plates Gross, Lb.	Calculated for Plates Net, Lb.	Rivets Per Cent Effic.	Rivets Double Shear (Lb. per Sq. In.)	Rivets Bearing (Lb. per Sq. In.)	Ultimate Weld Strength, Lb.
8	180,000	135,000	75.0	54,000	59,100	142,500
	180,000	120,000	66.7		78,800	
6	169,000	131,500	77.8	54,000	49,250	131,110
	157,700	112,500	71.3		59,100	
9	159,500	122,200	76.6	54,000	49,250	120,000
	157,700	112,500	71.3		59,100	
10	159,500	122,200	76.5	54,000	49,250	96,400
	105,000	75,000	71.4		39,400	
11	150,000	112,500	75.0	54,000	49,250	89,650
	105,000	75,000	71.4		39,400	

45,000 lb. given above, the calculated efficiency of the smallest—and of the best—weld, in shear, is 95.4 per cent.

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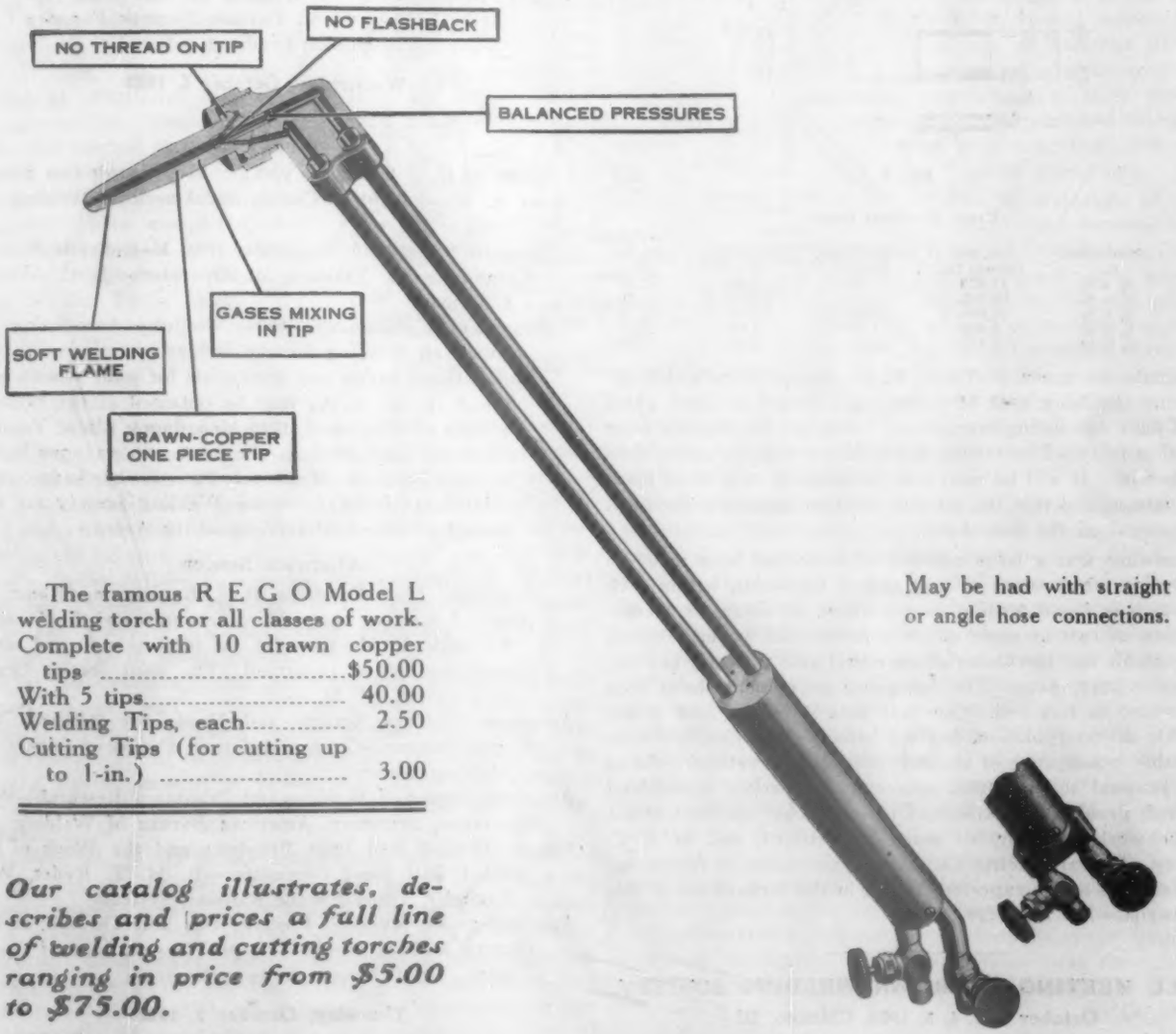

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Table V—Shear

Test No.	Calculated Area, Sq. In.	Calculated Strength, Lb.	Ultimate Weld Strength, Lb.	Per Cent Efficiency	Actual Weld (Lb. per Sq. In.)
8	4.23	190,500	142,500	74.8	33,650
6	3.60	162,000	131,110	80.9	36,400
9	3.18	143,200	120,000	83.8	37,730
10	2.50	112,400	96,400	85.8	38,600
11	2.09	94,000	89,650	95.4	42,900

Below is given an equation to show the length of bead required to develop the full strength of the plates used in the joint:

$$L = \frac{AT}{S} \text{ in which,}$$

A is cross sectional area of plate, or plates, in sq. in.; T is ultimate tensile strength of plates in lb. per sq. in.; S is strength per lineal inch of bead, which varies with the size of bead used, and which may be taken from Table VI; L is total length of bead required to develop full strength of plates.

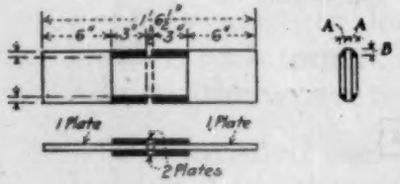


Fig. 8

Table VI—Cost Data

Test No.	Bead Size, In.	Lb. per Lineal In.	Total Time, Min.	Total Cost, c.	Cost per 1000 Lb., c.
8	½ x ½	11,870	33.00	33.00	2.78
6	½ x ⅜	10,925	19.87	19.87	1.82
9	⅜ x ⅜	10,000	22.75	22.75	2.28
10	⅜ x ¼	8,030	14.25	14.25	1.77
11	¼ x ¼	7,470	9.00	9.00	1.21

Results are given in Table VI of computations which determine the labor cost of depositing a length of bead which shall have a resisting strength of 1,000 lb. To simplify computation in this illustration, the welder's wage is assumed as 60c per hr. It will be seen that these costs vary in no regular manner, and that the weld of smallest section is the most economical of the five shown.

Knowing that a large number of tests had been made to determine the strength of butt and of lap welds, within each of which is found tension, compression, or shear, or a combination of two or more of these forces, the writer resolved to assemble test specimens which would give as nearly as practicable a pure shear. The foregoing experiments have been performed to this end. Our test data is limited and is not capable of exterpolation, but we believe that what we have available is indicative of the possibilities of structural welding in a rational and scientific manner. The writer is indebted to Prof. Frank P. McKibben, Union College, for his interest in the work, and for his many suggestions, and to B. C. Tracey, General Electric Co., for his assistance in furthering the progress of the experiments and in the preparation of this manuscript.—*The Iron Age.*

FALL MEETING AMERICAN WELDING SOCIETY

October 2, 3, 4, 5, 1922, Chicago, Ill.

PROGRAM

Monday, October 2, 1922

Committee Meeting

Afternoon Session

Western Society of Engineers, 1735 Monadnock Block.

2:00 P. M.—Committee on Specifications for Steel to be Welded—W. J. Beck, Chairman.

Tuesday, October 3, 1922

Committee Meetings and Technical Sessions

Morning Session

Western Society of Engineers, 1735 Monadnock Block.

10:00 A. M.—Electric-Arc Welding Committee—H. M. Hobart, Chairman.

Gas Welding Committee—S. W. Miller, Chairman.

Afternoon Session

Western Society of Engineers, 1735 Monadnock Block.

2:00 P. M.—General Properties of Cast Iron in so far as It Affects Its Weldability.

Note: Report prepared jointly by Gas, Electric & Thermit Welding Research Committees.

Gas Welding of Cast Iron—S. W. Miller, Union Carbide & Carbon Research Laboratories.

Thermit Welding of Cast Iron—J. H. Deppeler, Chief Engineer, Metal & Thermit Corporation.

Evening Session

Western Society of Engineers, 1735 Monadnock Block.

8:00 P. M.—Electric-Arc Welding of Cast Iron—Wm. Namack, Vice-president, Davison-Namack Foundry Co.

(Discussion of above papers.)

Wednesday, October 4, 1922

Committee meetings.

Morning Session

Office of H. J. Cook, Sec'y, Chic. Sec., People Gas Bldg.

10:00 A. M.—Executive Committee American Welding Society.

Western Society of Engineers, 1735 Monadnock Block.

Committee on Training of Operators—J. C. Wright, Chairman.

Joint Session American Electric Railway Association and American Welding Society.

Note: Guest badge and credentials for joint session with the A. E. R. E. A., may be obtained at the Western Society of Engineers, 1735 Monadnock Block, Tuesday afternoon and evening. Be sure and get your badge, as admission to Municipal Pier is by badge only. (Members of the American Welding Society are also invited to attend all sessions of the Aerea.)

Afternoon Session

Municipal Pier, Congress Hall, Engineering Room

Note: A meeting of the Way Committee of the Aerea at 2 o'clock, P. M., precedes the joint session and members are invited to attend. The joint session begins at 3 o'clock, P. M.

American Welding Society and Needs for Research and Standardization—C. A. McCune, President, American Welding Society.

American Bureau of Welding and Organized Research—Wm. Spraragen, Secretary, American Bureau of Welding.

List of Welded Rail Joint Problems and the Work of the Welded Rail Joint Committee—E. M. T. Ryder, Way Engineer, Third Avenue Railway Systems.

Applications of Welding, Electric, Gas and Thermit, in the Electric Railway Shops—J. S. McWhirter, Supt. of Equipment, Third Avenue Railway Systems.

Thursday, October 5, 1922

Committee Meeting

Morning Session

Municipal Pier, Congress Hall, Engineering Room

10:00 A. M.—Committee on Welded Rail Joints—G. K. Burgess, Chairman.

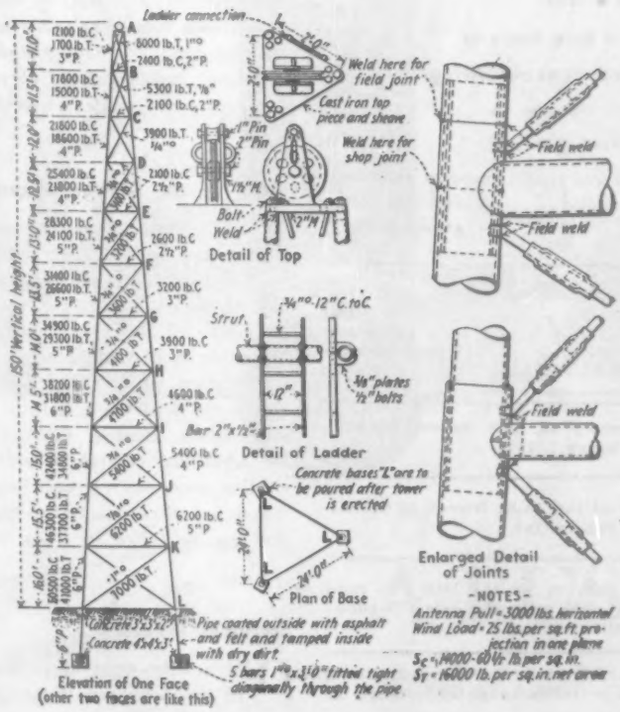
Note: All members are requested to meet at Hotel Morrisan, Wednesday evening, at 6 P. M. sharp, for a get-together dinner meeting.

ARC WELDED RADIO TOWERS

Simple Design Permits Cheap Construction—Main Members of Steel Pipe with Sleeve Joints — Rod Diagonals

By H. S. Bear*

TWO welded radio towers 150 ft. high, largely made of steel pipe, were built last year at Peking, China, as part of the wireless installation at the American Legation Guard. The station consists of one 30-kw. arc transmitting set and a triangular antenna supported by three steel towers. The main tower, 300 ft. high, situated in the Legation Guard compound, is of structural steel according to the standard design of the Bureau of Yards and Docks, U. S. Navy Department. It was fabricated at Pittsburgh by the Pittsburgh-Des Moines Steel Co., and erected by Etablissements Arnoult, of Peking, entirely with Chinese labor, the erection being completed in 2½ months. The two other towers, which stand on the top of the Tartar Wall, are only 150 ft. high, and were built by electric-welded construction.


Ladder connection
Weld here for field joint
Cast iron top piece and sheave
Weld here for shop joint
Field weld
Field weld
Field weld
Detail of Top
Strut
Detail of Ladder
Concrete bases "L" are to be poured after tower is erected
Plan of Base
Enlarged Detail of Joints
-NOTES-
Antenna Pull = 3000 lbs. horizontal
Wind Load = 25 lbs. per sq. ft. projection in one plane
Elevation of One Face (other two faces are like this)
Pipe coated outside with asphalt and felt and tamped inside with dry dirt.
5 bars 1" x 1/16" fitted tight diagonally through the pipe

Welded Radio Tower in Pekin, China.

Tartar Wall is 14 mi. in length, in the shape of a rectangle 4 mi. long and 3 mi. wide, and encloses part of the city of Peking. This wall averages approximately 50 ft. in width at the top and 30 ft. in height. It is constructed with brick sidewalls with a batter of about 1.4 and yellow clay filling. Note that all dimensions are approximate because, true to Chinese custom, the wall does not maintain definite lines except in a general way. Part of this wall forms one boundary of the American compound. The two towers are spaced 320 ft. apart and have a total height of 178 ft. above ground.

The requirements in this case were: (1) To support a horizontal antenna pull of 3,000 lb. at a height of 150 ft. above Tartar Wall; (2) to use a limited ground space (guys were not desirable); (3) to construct a permanent support; (4) to use a limited amount of funds; (5) to construct within a limited time; (6) the structure to present an aesthetic appearance.

Safety was of first importance because of the proximity of residences and quarters. Items 2, 3 and 6 eliminated the guyed wooden mast. There are no structural-steel fabricating shops in Peking, so that items 4 and 5 eliminated a structural-steel tower. After experimenting and estimating costs, the design as per Fig. 1 with a few exceptions was adopted. Ideas which were gained by experience in the construction of these towers are incorporated in the revised design.

There are several distinct advantages to be found in the design and construction of this tower. First, all members of the tower are round and hence they offer a relatively small resistance to the wind, which is important as a great part of the stresses produced on such a tower is caused by the force of the wind acting on the tower itself. Second, pipe sections give nearly perfect columns, having the greatest strength possible with a given amount of metal. Third, the details are so arranged as to make use of nearly all scraps resulting from the cutting of the main members. Fourth, electric welding is much easier, quicker and cheaper than riveting, on work of this nature, and if properly done it is just as reliable as riveted work. Fifth, the use of material of light weight permits the easy erection of long shop sections. Sixth, the finished tower has smooth, easy lines and offers a pleasing appearance.

The disadvantage of using standard pipe sections is the thinness of the metal. On this account great care must be taken in the original painting as well as in later repainting. It would probably have been better to have used no pipe under 2½-in. size.

Local conditions governed the design of the foundations and the top piece. Under other conditions both designs might well be changed.

Costs and methods of construction in China are no criterion for similar construction in the United States. Steel materials in the open market cost from two to five times as much in the United States. Skilled labor per man per hour is about one-tenth of the cost of American labor, but when quantity of production is considered it is very little cheaper, and when quality is considered it is not as cheap. Unskilled Chinese labor is about one-fifth of the cost of American unskilled labor. However, in the way of general information the following figures may be presented: The two towers, including foundations, all materials and labor and painting, cost the U. S. Government $10,000. Shop work was started on Feb. 15, 1921, and the work was completed on June 15, requiring a total of four months on two towers. The second tower, after gaining experience on the first, was completely assembled in position in seven days and completely welded in another seven days.

Etablissements Arnoult, of Peking, a French-American company employing only Chinese labor, was the contractor for the entire work.—*Engineering News-Record.*

Lieutenant, Civil Engineer Corps, U. S. Navy, Great Lakes, Ill.

It has been decided to postpone the Get-Together Luncheon of the Compressed Gas Manufacturers' Association until the October meeting of the Executive Board. This decision is due to the desire to have for presentation at that meeting complete results of important work now in progress at three laboratories. The September Board meeting will be held as usual at the secretary's office, but will NOT follow a luncheon of members.

The Welding Engineer

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The Welding Encyclopedia

IN announcing the Second Edition of *The Welding Encyclopedia* the publishers make grateful acknowledgment to the broad-minded practical men in this industry who have contributed so generously to it from their experience. The most casual reader cannot fail to observe that the information it contains has come almost directly from the men on the job. Many of the problems discussed are found to have several solutions, all of them tried and proven successful, so the reader can select one best suited to his own conditions. No single source could have supplied all this information. The volume actually presents opinions and experiences supplied from every corner of the welding industry. It is truly the welder's own book.

Keep up the Service Organization

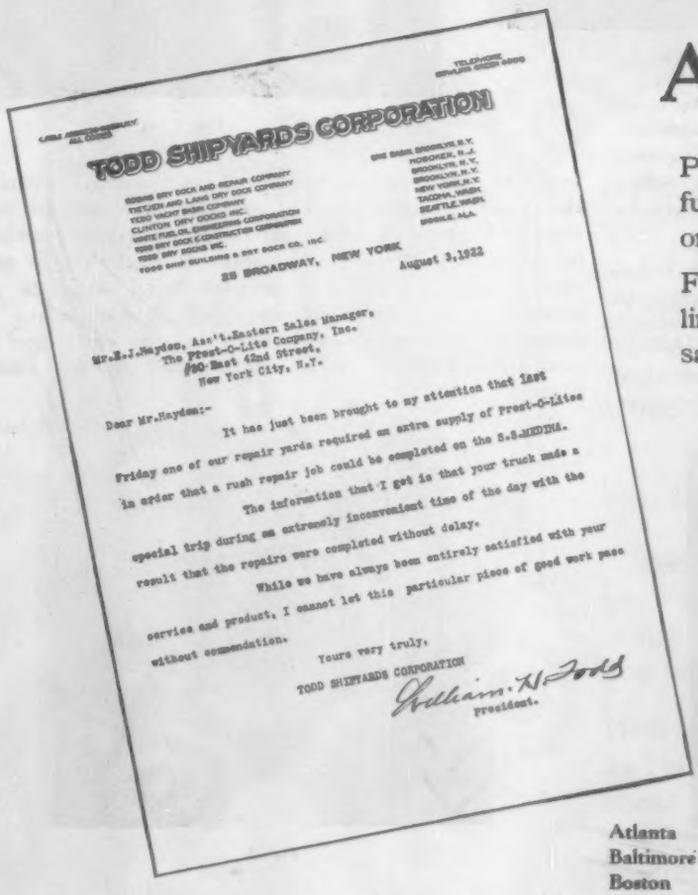
JUST as long as welding schools are so few and far between the manufacturers' service organizations will continue to be a vital necessity. At present the user of welding is largely dependent on his own resources for the training of his operators and he needs all the expert advice he can get. The service man brings to each welding department he visits a wealth of welding information gathered in the course of his daily routine. He makes the department a little wiser, a little more efficient, and a little better satisfied for his visit. Incidentally he finds uses for additional equipment, and creates additional respect for the welding processes. It will be a long time yet before enough provision has been made for training welders so that the service man can be called in from his job.

Sectional Research

ONE of the most important subjects before the Fall meeting of the American Welding Society at Chicago is the development of a program for research work to be carried on by the various sections. It is felt that every local section should be actively interested in at least one research problem so that the society as a whole can accomplish more results along these lines in the course of a year. The results as reported by the sectional research committees will of course be available to all members. The cumulative result of such a program worked to its logical conclusion will be a great fund of valuable welding information at the disposal of every member. It is hoped that all firms who are desirous of seeing research work done on particular problems as well as all firms who can supply facilities for making tests and investigations, whether members of the society or not, will be present at the October meeting to confer with the committee on research.

Is Your Shop Equipped

VERY few shops try to get along without at least one makeshift. One will use a cumbersome chain block instead of a good traveling hoist, another will carry all work to a stationary grinder istead of buying a portable one, a third will waste half its time with inefficient preheating devices. The completely equipped shop has them beat on at least one operation on every job. It is genuinely profitable to have a complete equipment, because it means being thoroughly organized. A welder should walk into his shop once in a while and look it over as though he intended to buy it, then decide what he would buy for it to make it satisfactory. Also, visits to other welding shops will result in acquaintance with new items of shop equipment which are worth having. While it is true that every piece of equipment costs money it is also true that any labor saver is also a money saver and will go on paying dividends after it has saved its cost.



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ARC WELDING ON LOCOMOTIVES

Welding Failures are Shown to Be Due to Improper Application of the Process Rather Than to Any Fault of the Process

By C. W. Roberts†

ELECTRIC arc welding, as we all know, is of comparatively recent origin, and as we believe in the American Welding Society is just in its infancy. As in everything else, we no sooner discover or perfect a new method, but what it is immediately subjected to abuse.

Electric are welding is now indispensable in a large number of our industries and will continue to increase in importance and efficiency. It will increase more rapidly if we all strive to eliminate the abuse that is brought about by carelessness, ignorance of limitations, and lack of interest.

Fig. 1

Fig. 2

Fig. 3

There is considerable discussion and differences of opinions as to just what should or should not be welded. It is undoubtedly true that in all processes of autogenous welding that an intense local heating is unavoidable and that in the cooling there is liable to be a certain amount of locked up stresses in some jobs.

Now the question I would like to have answered is: are these locked up stresses great enough and so menacing as to warrant the discontinuance of a large amount of our welding?

It is undoubtedly true that different locomotive parts that have been electrically welded have since failed, some after long and very hard service. Similar parts that have never been welded have failed also. I refer to such parts as crossheads, pistons, rocker arms, valve yokes, guides, link motion parts and similar machinery.

Fig. 4

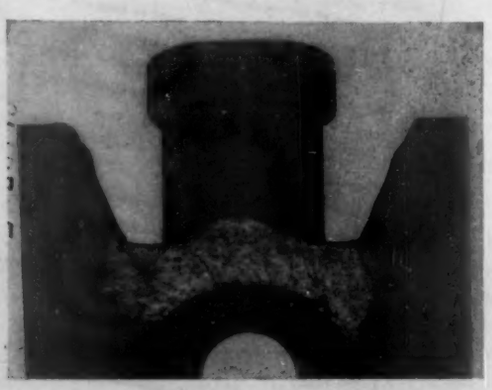

Fig. 5

Let us investigate these failures thoroughly and without prejudice or partiality, and find out if the failure was caused from locked up stresses, fatigued metals, faulty or inferi castings and forgings, or by the inefficient and careless weld or supervisor.

In electric arc welding, as in everything else, there are li itations, and an efficient supervisor will know these limitatio and will refuse to go beyond them, as he knows such wor only leads to the condemning of the entire practice of electri are welding. It therefore follows that to have efficient super vision your supervisor must have co-operation.

The greatest causes of failures are the inefficient and indi ferent workmen and the little heed taken to have a perfectly clean and properly prepared job; although suitable equipment and proper electrodes for the work at hand should not be overlooked. Your finished result, I might say, is 90 per cent operator, 10 per cent equipment and materials, while preparation and operation are about a 50-50 break. You cannot get thoroughly satisfactory results no matter how good your welder's ability may be, if the work is not first properly prepared.

Our men on this work with which I am most familiar are welders; they are able to do all kinds of autogenous welding. They are men who started at the bottom and were retained because of their ability and interest in welding. They have become proficient in all prases of electric arc welding and oxy-acetylene welding. They are welding operators, which is and should be recognized as a trade in itself; a trade in which a man should receive instructions and serve an apprenticeship, just as a boilermaker, blacksmith, machinist or any other craftsman. Just because a man is any one of these craftsmen, is

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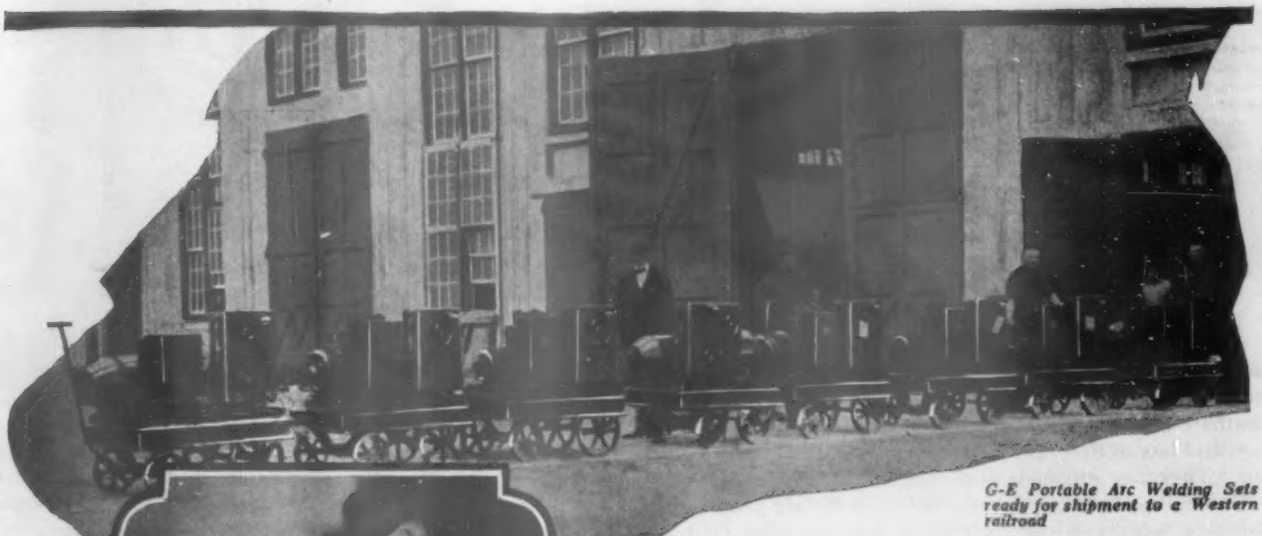
**Presented at the April, 1922, meeting of Pittsburgh Section, A. W. S.*

†Welding foreman, Pennsylvania Railroad, Columbus, Ohio.

Give a good welder the right arc welding equipment—and just watch the sparks fly!



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far from being an intelligent or rational reason why that man should be called a welder, given the welder's rate of pay and set to work. This is one of the chief reasons why today we have so much inferior work for which electric arc welding is being condemned. It should be the incapable operator and not the method that should be condemned.

Your craftsman may become a welder operator after he has received instructions and served his apprenticeship (if he has the ability), and he may be able to master all phases of electric arc welding and oxy-acetylene welding, such as firebox, boiler, machinery and equipment work, in the round house,

Fig. 6

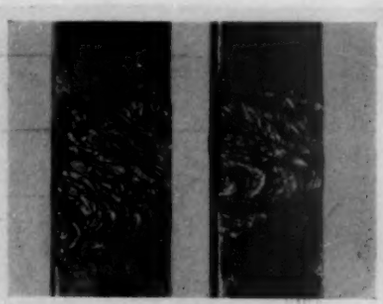


Fig. 7

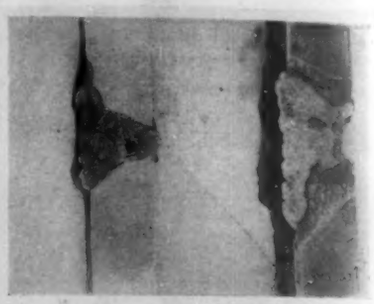


Fig. 8

back shop, yard or road. However, he will not acquire that ability in its entirety in six (6) days, six (6) weeks, or six (6) months. It takes perservance, endeavor, and actual experience, and lots of it, to make a thoroughly reliable welder operator. They are not made over night.

We employ both the carbon and metallic arc process and find very large and ever increasing field for both methods. The figures will give a slight idea of a few of our different operations.

Figure (No. 1) shows a cross section of a crosshead guide which was built up so as to finish 3/8 of an inch higher than the worn surface. This was done by making two runs of metal with the carbon arc. You will note the very uniform change of structure and heat penetration caused by the two runs of the arc in the original metal adjacent to the weld.

The scleroscopic test for hardness showed the welded metal to be much softer than the original steel which has a carbon content of about .55, while the filler rod conformed to the American Welding Society's specifications and contained .18 carbon. I have been pretty well convinced by these and other tests that an electrode should be used in most cases with a chemical analysis that will give you in the weld metal an analysis similar to that of the original metal.

Fig No. 2 shows a similar cross section as the previous slide. This was welded by the metallic arc process. Note the uneven line of penetration and the more pronounced and varied change in structure of the original steel. I might add for the information of those unfamiliar with the two methods that the cost of labor per inch is less than four (4) mills in the case of the carbon arc as against eighteen (18) mills in the metallic arc, or your metallic arc in this case costs four and one-half (4½) times as much as the carbon. If only one-fourth (¼) of an inch of finished metal is desired the difference will be only about 3 to 1.

With the carbon arc we use a 5/8 in. rod and in the metallic arc a 7/8 in. or ¼ in. rod.

Fig. No. 3 shows how easily electric arc welding can [illegible] and is condemned. It shows a crosshead that came into our round house after its run. You can see just what I found. You will notice that in the repairing of this job that the fracture was not followed to its end, but had been "Veed" out and welded where no fracture existed. About six (6) months later I traced this case down and found that an engine house foreman had ordered the crack partly Veed out, welded up and sent out. It got as far as the first inspection point after it left the point where the repairs were made. I then took the acetylene cutting torch and cut out a piece of one (1) inch wide each side of the weld. Fig. No. 4 will show you what I found. You will note that the fracture had been Veed out just ⅓ the thickness of the casting, welded over and sent out. It is simply suicide to put out such work, you must Vee out the crack entirely and clear through. If your original casting broke in service what do you expect out of a repair such as this? The original casting at this point when cut with the acetylene showed a very porous and badly oxidized metal. Even had the original crack been Veed out properly and welded carefully it would have failed as you will note a small crack which extended from the inside, where it would not have been found. Here then would have been an opportunity to condemn electric arc welding and failure might be attributed to locked up stresses. I might add that this crosshead had seen considerable service as the crosshead pin hole had been filled in by the metallic arc process and rebored and this is never done until after numerous machining has increased the diameter of the hole to the limit.

Fig. No. 5 shows the same crosshead after being welded by the carbon arc process.

During the war when supplies were scarce, most any material that could be obtained was used in electric arc welding and I believe from the appearance of some of our work today, this condition is still permitted to exist at some

Fig. 9

Fig. 10

Fig. 11

places. This should not be tolerated for proper and suitable electrodes and materials go a long ways toward producing satisfactory results.

Fig. No. 6 shows the truth of this statement in the matter of suitable electrodes for carbon arc welding. Electrodes one and two are 5/8 in. in diameter; both were placed in the holder jaw to extend through four inches; both were used constantly for 20 minutes under same voltage, amperage, and other conditions. No. 1 is a carbon and No. 2 a graphite electrode. The carbon decreased in length 1 7/8 in. and in diameter to 1/4 in. and burnt off the holder jaw as you will note, while No.

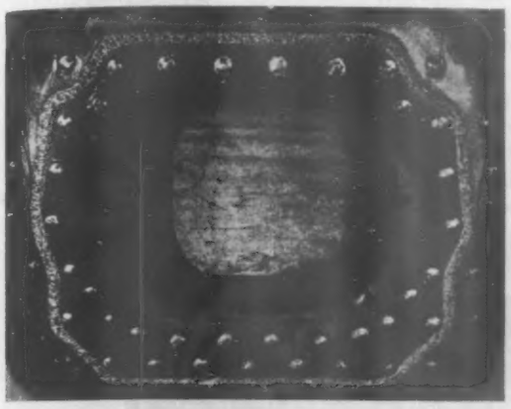


Fig. 12

2, which is graphite decreased in length 1 1/8 in. with a gradual taper and the holder jaw was not affected in the least. No. 3 is a 1/4 carbon, somewhat denser than No. 1 carbon. This lasted just 15 minutes (under same conditions as Nos. 1 and 2), when it dropped through the holder jaw having decreased 1/2 in. in length, also in diameter and burned out the jaws as you will note. A graphite electrode will carry your current in a straight even flowing arc with practically no whipping or spluttering of the flame, while a carbon electrode is unstable, will whip and twist and give a constant spluttering and squealing arc. Graphite electrodes keeps your welder operators amiable and contented and pays big dividends in the amount of work accomplished and the amount of electrodes and holder jaws saved to say nothing of the superior quality and even flow of metal.

We will now pass on to the metallic arc process as we use it in firebox work. Every welder operator considers himself your best welder, but an efficient supervisor knows his men and uses them according to their ability. When so much depends on a sound and thorough weld as in firebox work, employ only your highest trained men, men that have proven themselves by the actual result of their test stubs and whose ability is known beyond a doubt. Here perhaps more forcibly than in any other work, except flues, comes up the question of proper preparation before welding.

Fig. No. 7 gives a view of the fire side of two (2) firebox side sheet seam welds, both beveled to a 45 deg. angle, one with a 1/8 in. the other with a 3/16 in. opening between the two sheets. Both appear on the face or outward appearance to be very successful welds. But electric arc welds like men are not always what they appear outwardly. Note the uniformity of the welded metal in these two (2) specimens.

The result obtained in the two specimens can be seen from Fig. No. 8 which is a cross section view of these same specimens. Notice how the metal from the electrode is forced through the 1/8 in. opening and how it forms both corners of the "V" into a seam resembling a rivet head, also note the small amount of metal that is required to fill the "V" and properly finish the seam. This is the ideal prepared seam as

Fig. 13

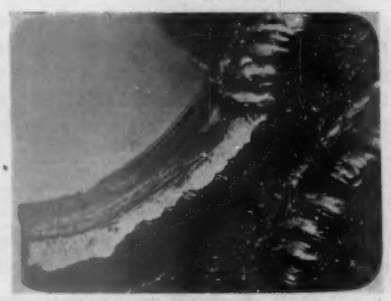


Fig. 14

it requires a minimum amount of electrode or added metal, and a minimum amount of heat which is of great importance in all firebox work. While the 3/8 in. opening as you see requires an excessive amount of welded material, and therefore, excessive heat. In the 3/8 in. opening or even 1/4 in. opening you cannot unite the two sheets with one run of your electrode as in the 1/8 in. opening, but must first make two or more runs on your lower sheet in order to make the opening small enough to unite the two sheets. The side and door sheets being of from 5/16 in. to 1/2 in. steel gives you a very narrow surface on which to build up, with the result that your inside corner is melted off and your metal after the first run will be very hard to control and as you are not able to see the back side, you get results similar to the above.

Fig. No. 9 is an enlarged view of electrically welded side

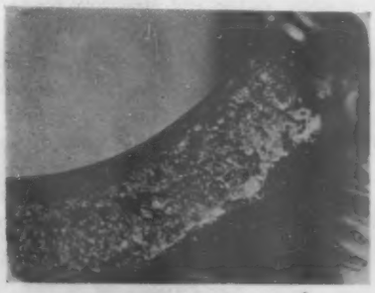


Fig. 15

Fig. 16

Fig. 17

sheet seams with 45 deg. bevel and a 1/8 in. opening. Note the rivet head effect of the seam and the line of heat penetration or change in structure of the parent metal.

Fig. No. 10 is a 3/4 side sheet the seam of which is being electrically welded. You can readily see the process of the two runs of the electrode, which completely finishes the seam. With a 45 deg. bevel in the two (2) sheets with a 1/8 in. opening, the welder is able to completely unite the two sheets and fill in about one-half of the "V" with the first run of the electrode. Care must be taken not to proceed too rapidly, so as to avoid an excessive amount of heat in the two sheets. Proceed slowly and weld thoroughly with your first run and you will never have one of these seams crack for you. The iron oxide (that has formed) should be completely brushed away with a wire hand brush, using a hand

hammer and chisel to remove any slag that has been formed on the edge of the "V." The second run of the electrode should completely fill the remainder of the "V" reinforcing the weld about 1/8 of an inch and extending beyond the two edges of the "V" about 1/8 in.

Prepare your seams in a straight line, but in door collars and all patches, studiously avoid square corners. Fig. (No. 11) illustrates a side sheet patch. Fig. (No. 12) shows the practice in welding in a door hole collar.

No electric arc weld is as strong as the original sheet for the simple reason that the metal deposited through the arc is necessarily a cast metal, while your sheets are forged or rolled steel. Therefore, the more thorough your preparation of the sheets and the less welded material in your seams, the stronger your finished job. Use a 1/8 or 5/32 electrode, with the chemical properties about as follows:

Carbon not over	0.18
Maganese	0.64
Sulphur and phosphorus	0.05

Electric arc welding gives a stronger seam than riveting and there is never any future work necessary, such as caulking.

Fig. 18

Your riveted seams give about 60 per cent of the strength of the original steel, while I have gotten as much as 96 per cent in an electric arc weld.

I have a test report here that I want to give you just to show what results are possible in metallic electrode welding. These tests coupons were welded under the same conditions as I have described in the firebox, seam welded and are the results obtained by three of my welders.

Specimen	Elongation in 2 in.	Load Pounds per sq. inch	Efficiency
1	6.5%	42,700	
2	8.5%	52,800	
3	5.0%	47,600	
Avg. (above)	6.7%	47,700	86.7%
Avg. (3 others)	7.0%	51,400	93.5%
4	8.0%	51,900	
5	8.0%	53,300	
6	7.0%	51,400	
Avg. (above)	7.7%	52,200	94.6%

The original tensile strength was 55,000 per square inch.

These coupons were 1/2 in. boiler steel which were shaped smooth before testing, leaving no welding reinforcement.

These tests were made at the Ohio State University by Professor D. J. Demerest, Professor of Mines and Metallurgy.

Now the next question in your mind, no doubt, is what is the cost in comparison with a riveted seam. I will say in so far as I have investigated, that to rivet in these seams (labor and material) it will run from 90c to $1.25 per lineal foot, while with the metallic electrode these seams, electric energy at 3c per k. w. hour (140 amperes at 92 volts or 22 volts across the arc), will cost per foot, .09c, 5/32 electrodes at 7.5c per lb.; per foot, .05c; 25 min. time for welder operator (a) 50c per hour; per foot, .21c, making the entire cost per lineal foot 35 cents.

The question of proper procedure and method of flue welding is an open one and perhaps some of you may differ with me on the subject. I am not prepared to say that the method we pursue is best, but am simply going to give you a few facts as I have found them.

First, last and always, I am talking and insisting on proper preparation before welding any job, and in flue welding cleanliness and proper preparation are the first considerations. If your flue sheet is a new one, sand blasting thoroughly will give you a clean sheet, if an old sheet and one that has been welded before, the previous weld must be chipped clean from the sheet. Place your copper ferrules so that after rolling them in place they will set back from the fireside of the sheet about 1/8 of an inch. This will leave your copper back far enough so that when the flue is expanded and beaded down the copper ferrule will not interfere with your weld. Set your flues in the usual manner, leaving the small flues extend through the back flue sheet about 1/8 of an inch and the superheater flues 1/4 of an inch.

The boiler is then given the regular hydrostatic test and all leaking flues tightened for if your flues are not tight in the

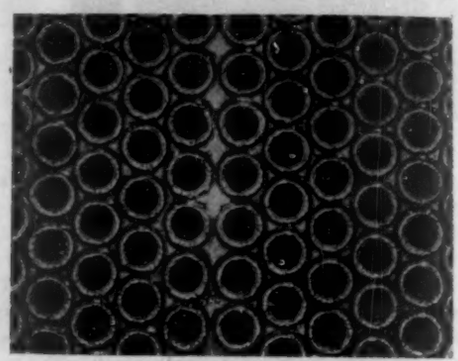


Fig. 19

sheet before welding, they will not be after. Keep oil and grease off the flue bead and sheet. Now sand blast your flues and sheet clean of all dirt and scale, bead down your flues tight against the sheet, or your beads will burn off in welding, fill your boilers with water and you are ready to weld.

Start at the top of the sheet and progress downward, starting each flue at the bottom, progressing first up one side, then the other, meeting at the top of the flue. Weld first to your flue sheet out from the flue bead the thickness of your welding wire or 1/8 of an inch, then by a weaving movement weld to the crown of your flue, bead back and forth until you have completed the flue. This will give you a strong weld on the sheet and enough metal on the flue beads to protect them.

Fig. 13 shows you a 2-inch flue, welded with 1/8 inch electrodes, using 140 amperes and 21 volts across the arc. In this case the copper ferrule was properly set so as not to interfere with the welding. The flue beaded down tight against the sheet. No oil or grease was used on the flue sheet and the sheet was cleaned with the sand blast. The boiler was then filled with water and welded. This flue was then sawed horizontally and the strip of flue bent back and forth and finally broken off by a hand hammer and chisel. Notice how smooth and uniform the weld is applied in this case.

Fig. No. 14 welded under the same conditions as the previous flue, excepting no water was used in the boiler. There was no oil or grease on the sheet or flue and copper ferrule so placed as not to enter into the weld. Note the clean metal shown when this flue was broken down and the perfect penetration and fusion of the weld. These two flues were each welded by a different operator.

Fig. No. 15 shows a flue that had been set just the same as the preceding two (no oil or grease used, sand blasted clean, copper ferrule placed as in the other two). The amperage, however, was 170 with the voltage across the arc at about 26. When this flue was sawed horizontally and bent back the whole weld popped off the sheet.

You can readily see by the pocked and cinder appearance just what took place in this case. The welder operator who did this work also welded the first flue shown above.

Fig. 16 shows a result quite different from the preceding slides, and shows very convincingly the necessity of cleanliness and proper preparation. In this flue the copper ferrule was placed in the sheet and allowed to come flush on the firebox side with the result that when the ferrule was rolled tight and the flue set and beaded down the copper protruded out under the bead. Oil was used freely on sheet and flue bead. You can readily see how this copper ferrule extended out under the flue bead and how it was burned out by the metallic electrode.

Note the porous and slag like appearance of the metal. This condition is caused by the burning of the copper and oil by the steel electrode, which forms a copper monoxide gas. This gas being densest at its source, which is the flue bead and sheet prevents the molten metal from the electrode from properly fusing with the parent metal, and the entrapped vapors in liberating itself forms the slag like porous structure that you see.

Fig. 17 shows the result of the same preparation as the previous one. Note the appearance of the welded metal, also the uneven application of the metal, how it has splashed and run down. With a clean properly prepared flue job your welder is able to apply the weld in a uniform manner, progressing rapidly and thoroughly as the metal penetrates or dives in and is readily controlled. While in an oil soaked and dirty sheet or one with the copper ferrules interfering your metal has not that snap, that clean fusion or penetration. You cannot progress with regularity as your arc is unstable and the metal backs up on the electrode and runs down on the sheet.

Fig. 18 shows a cross section view. Notice how the copper ferrule is placed in these two flues. One placed ¼ back from the fire side of the sheet with the result that we have perfect penetration and a clean weld. While in the other the copper ferrule was allowed to extend out under the bead with the result as you see it here, poor penetration, porous metal, and an excessive amount as in welding under these conditions, your metal backs up and runs out.

Fig. 19 gives a view of a flue sheet in which all the flues have been electrically welded. The cross denotes the center of the sheet and divides it into four parts, each welded by a different operator. Note the smooth and uniform welds.

In welding in flues with the metallic arc process the cost per flue is as follows:

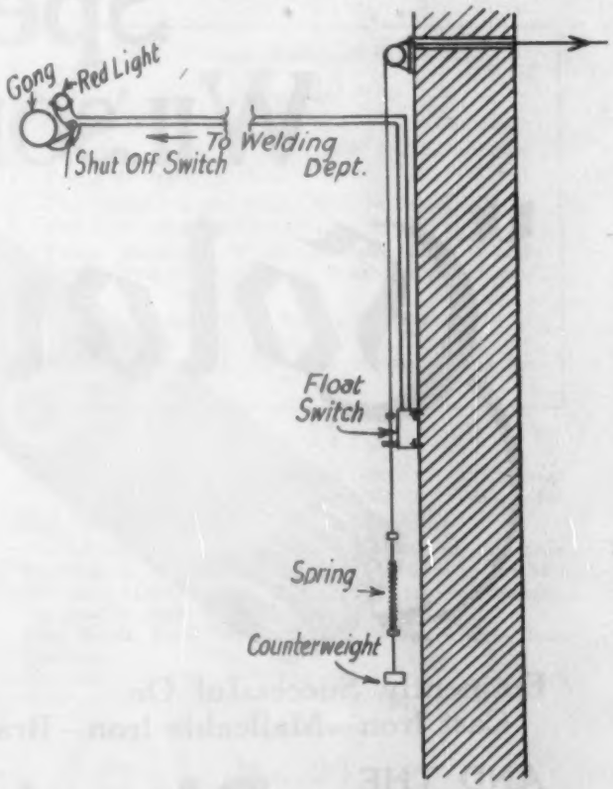
Electric energy	$.017
Labor at 78c. per hour	.025
Metallic electrode material	.009
Total cost per flue	$.051

In closing let me urge that we all, welding engineers, supervisors, and welder operators, do our utmost and be ever alert to eliminate the abuses that are liable to occur in electric arc welding; for the more perfect our results the greater the demand for our work. We know that no other method of new or repair work, within its limitations can be done as economically as by electric arc welding.

RINGS BELL WHEN CARBIDE GETS LOW

Editor:—

Am enclosing a sketch of a little device of my own which I think might be of value to other welders. It is to indicate when the carbide in the generator hopper is about used up. In our case the generator house is located in another building about 100 feet away from the welding shop and as we do not have a man to look after the generator we would not know how near empty the carbide hopper was until it was exhausted, with the result that we have almost spoiled several important welding jobs. With the indicator we have it set so that the gong will ring about 40 minutes before



Bell Rings When Carbide Gets Low.

carbide is exhausted so that we can take care of any job we have on hand. The indicator can be adjusted to any length of time desired by adjusting the trip so that the gong will ring at desired time. The second sketch shows a little device for holding all sizes of welding tips and is located at all of our welding stations. It saves time, as you do not have to hunt for tips when changing from one size to another; and we sometimes have to change five or six times in an hour. Yours for better welding,

Geo. W. Cooper.

ELECTRIC ARC RIVET CUTTING TRANSFORMER

A transformer for electric arc cutting of rivets has recently been announced by the Electric Arc Cutting and Welding Co., Newark, N. J. The machine is made in three sizes. The Type CW, 300-amp. machine, is intended for both welding and cutting, the 600-amp. machine for rivet cutting and carbon arc welding, and the 1,000-amp. for cutting alone. The primary magnet wire has micanite between the layers, while double micanite and asbestos spacers are placed between the primary and the secondary winding. There are large air ducts between the iron and the copper and between the layers of the copper. A bucket type of ball bearing blower is arranged to drive air through these spaces continuously whenever power is being used in the transformer. In order to reduce the power required to magnetize the core, an automatic cut-off arrangement is provided. A magnetically operated switch is provided in the primary, so that the circuit remains open at all times when the electrode is not in contact with the work, or when the arc is not being drawn. A small pilot transformer of 100 watts capacity is employed, making the operation automatic and positive.

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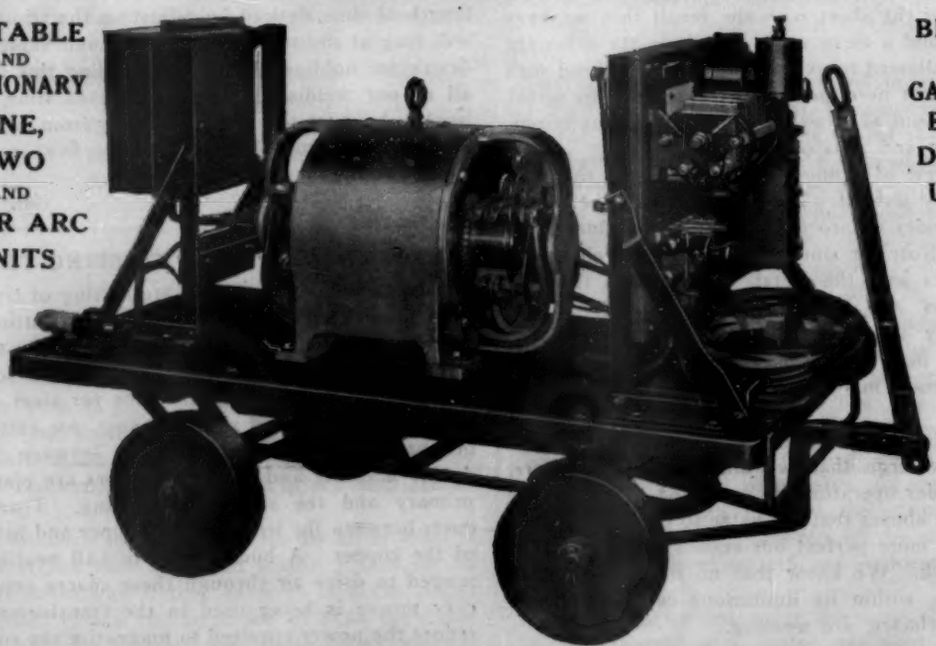

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"Color-tipt" Metal Specifications

For Welding Cast Iron

No. 12

Grade Color "GREY" *.148" (5/32") Diameter*
Sizes: *.120" (1/8") Diameter*
.093" (3/32") Diameter

For Flat Welding Only

This metal will penetrate cast iron and produce a homogeneous and machineable weld. Readily caulked when cold.

Current recommended 175 amperes with .148", 100 to 130 amperes with .120", 80 amperes with .093" metal and a short arc.

No. 4

Grade Color "GREEN" *Size: .148" (5/32") Diameter*

For Flat, Vertical and Overhead Welding

This metal will produce an extremely hard surface on steel and is not machineable. For use where resistance to wear is an important factor.
Guides, Rock-Crusher Jaws, Frogs, Rail Heads and Switch Points.
Current recommended 100 to 135 amperes and a short arc.

No. 6

Grade Color "WHITE" *Sizes: .148" (5/32") Diameter*
.120" (1/8") Diameter

For Flat, Vertical and Overhead Welding

This metal will produce a weld in steel of about 50,000 to 60,000 lbs. per square inch tensile strength and of medium ductility.
Current recommended 120 to 140 amperes with .148" and 100 to 120 amperes with .120" metal.

No. 8

Grade Color "ORANGE" *Sizes: .148" (5/32") Diameter*
.120" (1/8") Diameter

For Flat, Vertical and Overhead Welding

This metal will produce a weld in steel of about 50,000 lbs. per square inch tensile strength and is readily machineable. For use in building up worn places not subject to excessive wear.
Current recommended 115 to 135 amperes with .148" and 100 to 115 amperes with .120" metal.

No. 9

Grade Color "BLUE" *Sizes: .148" (5/32") Diameter*
.120" (1/8") Diameter

For Flat, Vertical and Overhead Welding

This metal will produce a weld in steel of over 60,000 lbs. per square inch, tensile strength and an elongation of about 15% in one inch in a mechanically sound weld. Machineable at reduced tool speed.
Automobile Frames, Boiler Plate, Cast Steel Parts, Locomotive Frames, Firebox Seams, Flue Sheet Patches, High Pressure Boiler Work, Oil, Gas and Steam Pipes, Ship Plates, Tanks, Fish Plates, and Rail Bonds.
Current recommended 135 amperes with .148" diameter, 100 to 125 amperes with .120" metal.

For Welding Brass and Bronze

No. 20

Grade Color "BROWN" *.148" (5/32") Diameter*
Sizes: *.120" (1/8") Diameter*

For Flat Welding Only

This metal will produce a weld in brass, bronze and light gauge copper.

Pump Castings, Water Wheels, Motor End Rings, Tail Shaft Sleeves, Bearings, and Castings.

Current recommended **Reversed Polarity** 150 to 180 amperes with .148", 100 to 120 amperes with .120" metal and open circuit voltage of about 45 volts.

No. 17

Grade Color "Red" *Sizes: .148" (5/32") Diameter*
.120" (1/8") Diameter

For Flat, Vertical and Overhead Welding

This metal will produce a sound weld in cast iron where studs are used and in steel a weld of about 50,000 to 55,000 lbs. per square inch tensile strength. On steel is easily machineable.
Flue Work, Steel Castings, Blow Holes in Grey Iron Castings.
Current recommended 130 to 145 amperes with .148", 100 to 125 amperes with .120" metal.

No. 30

Grade Color "YELLOW" *Sizes: .148" (5/32") Diameter*
.120" (1/8") Diameter

For Flat, Vertical and Overhead Welding

This metal is fast and smooth flowing and will produce a weld in steel of about 50,000 to 55,000 lbs. per square inch tensile strength. For use where a smooth and rapid deposit of metal is required. Will also produce a sound weld in cast iron where studs are used.
Current recommended 125 to 145 amperes with .148", 100 to 125 amperes with .120" metal.

No. 31

Grade Color "LAVENDER" *Sizes: .148" (5/32") Diam.*
.120" (1/8") Diam.

For Flat, Vertical and Overhead Welding

This metal is particularly fast and smooth flowing and will produce a weld in steel of about 50,000 to 55,000 lbs. per square inch tensile strength.
Current recommended 100 to 115 amperes with .148" and 85 to 100 amperes with .120" metal.

No. 33

Grade Color "BLACK" *Sizes: .148" (5/32") Diameter*
.120" (1/8") Diameter

For Flat, Vertical and Overhead Welding

This metal is fast flowing and will produce a weld in steel of about 55,000 to 65,000 lbs. per square inch tensile strength with high ductility.
Current recommended 115 to 125 amperes with .148" and 100 to 115 amperes with .120" metal.

Samples on Request.

GOGGLES OR SPECTACLES?

Selection of Goggles Should Be Determined by Adaptability Rather Than on the Basis of Price

Indianapolis, Ind.

Dear Ed:

The South it is, just as I expected and I've got to get there in a hurry too. While the boss lets you have it sort of easy-like, its seldom he rushes the boys out of town the way he did me. I had absolutely no occasion for stopping here at all and if I could have waited for the evening train out of Chicago it would take me right through to Georgia without a change. Something was evidently up that I wasn't in on for instead of taking that train out of Chicago I was told to jump on the noon train and wait here for the late train. Between the rail strike, coal strike, and this hot weather perhaps the old man's a bit unhinged. Well, I missed my swim in the lake this afternoon and am headed south at the wrong season of the year so now we don't care what happens.

Looked up my old friend Read Williams when I got here and found that he had just opened up a new place. There were a couple of welders chewing the rag in his office, it being after working hours, and they had some interesting ways of looking at things. I thought their discussion of welding goggles was especially good so am recording it as near as I can remember, in hopes that you will enjoy it too.

Says welder number one, "I wonder if there is anything in this talk about the welding flame being hard on a fellow's eyes? A salesman was over at the shop this afternoon selling apparatus and supplies and the way he talked you'd think a welder would go blind in the next five minutes if he didn't dig up five bucks for a pair of his special welders goggles."

"Don't fall for stuff like that, it's all the bunk," said welder number two, "he's just trying to make a sale. Says number one, "At the same time there may be some truth in what he says about the flame having the harmful rays and hurting the eyes. When a fellow is only blessed with one pair of eyes he doesn't like to take any chances. It would be different if it were your first set of teeth or your hair or something like that, that is replaceable but the eyes are one thing I don't like to take any chances on."

"Can't blame you if you feel that way about it," number two said, "but I'd like to tell you a thing or two about my personal experience and then you can form your own opinions and choose your next pair of goggles with perhaps a greater feeling of security."

"When I first got interested in welding in 1908 it was back in New York and very little was known about it then, so you see I was one of the pioneers in the game. At first I almost ruined my eyes and I'll tell you how. Not knowing any better I got two or three of the darkest glasses I could find and put them all together. I was not going to take any chances with my eyes and if the welding flame was harmful, I was going to see to it that all the harmful part was cut out. The first few days I didn't have any trouble because there wasn't a great deal of work to do and what there was, all was on the small variety and the torch wasn't going much of the time. You see, in those days people didn't know what welding meant and there was no big jobs at all. We thought it was wonderful when we welded castings together that were a quarter of an inch thick. As I was saying, the first few days all went well but one day I had quite a rush of work and has the torch going almost twice as long as any other day. That meant that I wore the goggles just twice as long. Well, that night my eyes bothered me and I sure was worried. Right then and there I was on the point of giving up welding but the money I had taken in that day and the fact that it was the most interesting work I had ever done made me change my mind. I would get down to brass tacks and figure out some kind of a glass that would not hurt the eyes. The next day I purchased another piece of dark glass and added it to my three glass goggle, making it still darker. That night my eyes, if anything, were worse. They pained me and I could hardly sleep. Thinking that perhaps they were tired from the previous day and needed a rest I didn't do any welding the next day. On the day following I had an extra amount of work to do and that night my eyes again bothered me. I decided to add darker glasses until I had all the flame cut out but of no avail, my eyes hurt and there was no denying the fact."

"Something had to be done to relieve the strain on the eyes so I figured that a change of color might have some influence. I tried dark blue, brown, black and one or two others and even tried combining different colors but without much success. Then one night as I was lying in bed a thought struck me. Could it be possible that I was straining my eyes by blinding them? Perhaps instead of making my glasses darker I should have tried lighter. The more I thought of it the more certain I was that I had at last struck the right way. I recalled that when reading a newspaper in the dusk I would feel the same effect. Was it not the same kind of a strain? In my excitement I bounded out of bed and slipped into some clothes, determined to run downstairs, where my apparatus was, and test out the lighter glasses. After some searching, I found a glass that was very much lighter than any of the others and by placing this in the frame I lit my torch and started in. Well, it certainly seemed better but I was in no condition to give a real test then. I decided that I'd turn in and the next day I would have a better chance to do some real trying when my eyes were rested. When noon rolled around on the following day my eyes felt fine and at night the same, so you can probably imagine how I felt. The lighter glass was the solution."

"Knowing that the dark shades I had been using were the cause of my trouble," he continued, "and finding such relief in the lighter shade, I hit upon the idea of testing out the different colors to see if it made any difference so that I could tell just what was what. Well sir; although I tried about every color in the rainbow, as long as I kept to a light shade, all was fine. There was only one conclusion I could draw, namely, that it wasn't the color of the glass that influenced my eyes but it was the shade. I found as I just said, that the lighter the shade the better, up to certain limits of course, and the darker the shade the greater the strain became.

"That experiment happened many years ago," he went on, "but I've stuck to the welding ever since, except the year and a half I was in the navy, and I have never had a particle of trouble with my eyes. I wear a fairly light shade goggle of a smoked green color. When I entered the service my eyes were examined very closely and they tested perfect. I've never had tired eyes nor have they ever seemed strained since I picked out this lighter shade, so you see I have perfectly good reasons for believing that your salesman friend may have been trying to slip something over on you."

"That may be all very well in your own particular case," answered welder number two, "but how are the rest of us to know whether the style of goggle you wear will be the one for us. All our eyes are different. What may apply to one case may not suit all. I suppose you will now come back and tell me to have an optician fit me with the proper shade and then stick by them."

"Your stand is well taken and I intended to dwell upon that very point but I overlooked it," number one said. "It's

true that people's eyes differ and what will suit one won't appeal to another. It is not necessary to go to an optician as you suggest but any man can test out his glasses very quickly and tell whether they are the right shade for his eyes. Naturally, if he finds the correct shade, he should stick by it. That goes without saying. What I'm going to do now, is tell you how to test the glass and give my reasons for believing the procedure I outline to be correct. Now I'm no eye specialist and furthermore I don't know a "violet-ray" or an "Infra-red ray" from a sack of green apples. Experts tell us that both these rays are present in the welding flame and that both are injurious to the naked eye. This may all be true but they don't tell us how many rays or to what extent they are present in the welding flame. Personally I don't see how they can be very prominent from the fact that in manufacturing plants where there are many torches engaged in the production of cooking utensils and such the operators weld year in and year out without a goggle or glass of any kind. Yet their sight is not injured in any way. It may be, as I mentioned, that these rays are present but to such a small extent that they are to all intents and purposes, not noticeable. If such is the case, then the only thing to guard against is the glare of the light when the heat causes the steel to reach the incandescent point or when a flux, strong in sodium, is brought in contact with the flame. The eye must be protected against the brilliancy of such lights and of course from the flying sparks."

The welding goggle for complete protection completely encloses the eye.

"The question arises, how dark shall the glass be? This question is one which the welder has to decide for himself. Nobody can pick out a glass and say, "Here is the shade for you"; he must do his own choosing. This is not difficult. Pick out a glass that will just cut out the glare and let you see the part being welded. The lighter the shade the better but of course its no good unless its dark enough to let the welder see what he's doing. The color? Use any color; whatever is pleasing to the eye. My reason for believing this advice is right is because I've had occasion to test it out on very different welders and in every instance it has been successful. They say that the proof of the pudding is in the eating, so there you are, Q. E. D."

"If what you say is correct, then a whole lot of welders are on the wrong track when it comes to buying their goggles," number one added, "I know a lot of fellows who think that the more they pay for a pair of goggles the better and more certain the protection."

"You can readily see why they are wrong can't you?" number two asked. "The price has no bearing on the shade. A fellow may buy the biggest priced and best goggle on the market and yet it may be the worst thing possible for his eyes because it isn't the right shade. It so happens that most of the goggle manufacturers realize this condition now, and are turning out different shade lens and number them so the welder can choose his own shade. One goggle I saw not long ago had three very thin lenses, all of a very light shade. The three could be used together or, if too dark one or two could be taken whenever the user wished. When I saw this goggle I couldn't help but think that somebody else probably had the same trouble in getting fixed up that I did only when they found the solution they got word to the goggle maker and are probably drawing a little royalty on every goggle of this kind turned out. Great Stuff!"

"Well Ed., I thought I'd take a chance and put a question to him on a subject I had long been wondering about, to get his viewpoint. So I asked him which he preferred for ordinary bench work, a goggle that completely housed the eye or specs that had no protection on the side, and he reasons.

"Well sir!" he said, "I have some very strong personal views on that very subject. I'm all for the plain glass or specs as you call them, and I'll tell you why. We all know that the eye is composed of more than ninety-eight percent water. When working on a large job there is a great deal of heat given off and if the eye is all housed up its going to sweat and become bloodshot. For that reason I believe in the greatest amount of ventilation possible. With a glass we get this opportunity and furthermore, instead of wearing my specs way up close to my eyes I do just the opposite from most welders and wear them down on the end of my nose. This serves sort of a double purpose. It gives my eyes more ventilation and it also gives me a chance to peek over the top and give a glance at my gauges, pick up my rods or flux or see if the boss or any customers are coming in. With a goggle you can't do these things and personally I can't see why ninety-nine welders out of every hundred, insist upon wearing goggles. Its perfectly true that goggles have their place. If a fellow has to do any overhead welding, boiler work (in fire-box), or cutting, then he's perfectly justified in protecting his eyes all around and that's where a goggle comes in but you asked about bench work and that's where I recommend a pair of specs."

The Welding Spectacle. Adaptable for protection from dangerous rays and for looking over the tops at gauges.

"Is there any particular specs that appeal to you more than others?" I asked.

"There are a number of different kinds that are very good," he replied. "When I put my O. K. on a pair of specs there are three things I keep in mind besides getting the right shade. You can easily remember them. The first thing is to get a pair that has no metal exposed to burn the nose or the sides of the temple. The fibre type are very good. Next, see that the lenses are large enough to give ample protection. The larger the better. Now the third point isn't so important but it's a nice thing to have if available. It is a removable lens feature with a replaceable plain cover-glass which protects the lenses from flying sparks. When this cover-glass becomes pitted it can then be taken out and be replaced with another plain glass at very little expense and the specs are then as good as new."

That ended the discussion on goggles and I think that you'll agree with me that some of his points were well taken; at least they give food for thought and might be worth trying if a fellow were experiencing any trouble with his eyes.

As for me Ed, it seems to me I heard somebody announce about an hour ago that the night sleepers were all ready for occupancy. There I have been, in the waiting room, dashing this letter off while I remembered the stuff, with my bag in my lap taking the place of a desk. I'll bet they think I'm another crazy or I'm writing home for money. Methinks I'll heed the call. Kindly overlook the stationery, its the best I could gather up this time.

Same as ever,

Shep.

AN UNUSUAL CAST IRON WELD

Recently one of the country's "old time" welders, whose knowledge of the industry extends over a dozen years and all of the United States, was asked what, in his opinion, was the best cast iron weld he had ever seen. Without hesitation he replied, "Wait one minute and I will show it to you."

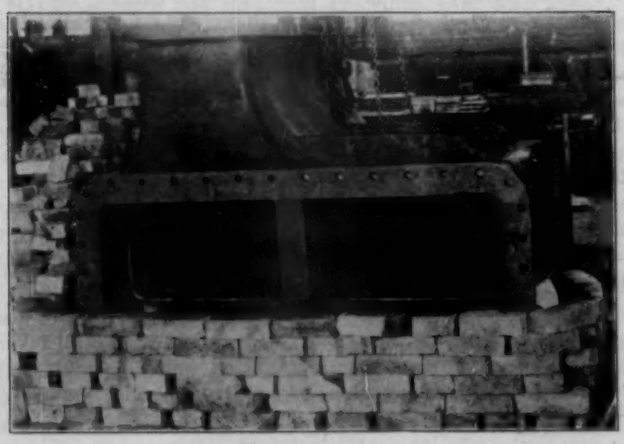
With that he began delving into a brief case—No, he is not a salesman—and presently he brought forth a series of pictures. Some of these pictures are reproduced herewith. A welding engineer who was present remarked, "I know that job. That was done out in Chicago—let me think—why, that must have been five or six years ago."

"It was longer ago than that," replied the welder. "If I am not mistaken, it was either in 1914 or 1915. It is a 7,600-lb. gray iron manifold that was used to connect the exhaust outlet of a large steam turbine with the inlet to the condenser. There were some changes being made in the plant and the casting either had to be cut down or replaced with a new one. A new casting would have cost several hundred dollars and it would have taken nearly a month to have it made and delivered."

Drilling Holes Along Line Of Cut.

"It would be no trick at all to cut a section out with oxy-acetylene today," interjected a young welder.

"No," agreed the speaker, and he added, smiling reminiscently, "I remember the magazine comments of the day, that it 'was impossible to cut the cast iron with an oxy-acetylene flame.' We can afford to smile at that now, when we are cutting gray iron castings every day with the torch. But I'm getting ahead of my story.



The Brick Preheating Furnace.

"The general superintendent of the power house for which this work was done first satisfied himself that the casting could be reduced by cutting and welding without impairing it in any way, and that he would save both time and money by having the job done. It was then shipped to the Chicago job shop of the Oxweld Acetylene Company.

"Specifications for the job called for shortening the boss of the casting 18 inches. There were three large flanges, each at right angles to both of the others, and these had to be kept absolutely in true, as the slightest warping or error in set up would render the casting valueless because of the necessity for absolutely steam-tight joints after installation. It was a real job, I can tell you."

By this time the young welder, wise in the progress of welding and cutting of today, broke in admiringly, "Those birds certainly had their nerve!"

"They had," assented the old timer. "And they had their wits, too. The pictures show how the job was handled. The first thing was to drill an almost continuous series of holes along the line of the cut. This was done with electric drills. Then, after the cut out section was removed, the flange section was set up in position to weld to the main body of the manifold. A brick preheating furnace was built around the parts and the whole layout topped with asbestos sheets, just as you would do it today. The fuel was charcoal and the fire was kept up until the welding was done, the asbestos being opened only enough to give the welders room to work. It took four operators 36 hours, during which time there was no let up on the job. Of course, the casting was cooled down slowly, after which the weld was finished off. The whole thing took only about 12 days, including the 10 days the casting was on the road.

The Completed Job.

"I cannot recall just what the job cost, but, counting in transportation, it was less than a new casting would have cost, and it saved about two weeks, which was worth many times any possible expense in such a case.

"Of course," added the welder, "there have been many larger cast iron jobs, but I regard this one as the best, all things considered, that I have ever seen."—*Power*.

The Lamar Welding Co. Atlanta Ga., recently organized, has acquired the plant of the Standard Gas Products Co., formerly known as the Bird-Wilcox Co., and will operate a welding and general repair works. John Lamar heads the company.

E. F. Lindgren has been named manager of the southeastern plant of the Air Reduction Sales Co., Birmingham, Ala., succeeding H. G. Boyner. The company recently moved its plant from Atlanta to Birmingham where a new plant is being established.

The Niagara Welding & Boiler Works, Inc., 1140 Whitney Avenue, Niagara Falls, N. Y. was recently incorporated to manufacture boilers and other iron products. It has taken over the business of the Niagara Welding Works and will continue boiler making and welding. It does not intend to manufacture at present. The incorporators are W. I. Grantham, J. Karon and H. J. Cantara, all of Niagara Falls.

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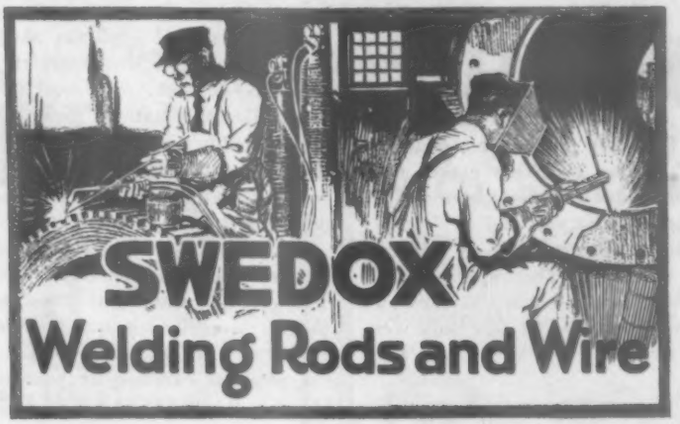

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FLUXES—CASTOX, BRONZOX and ALUMINOX FLUXES when used with the corresponding non-ferrous filler rod will keep impurities out of the weld and promote thorough fusion.

FREE trial samples of any product will be furnished upon request. A trial of any SWEDOX product will convince you of its superiority. Send for these samples NOW.

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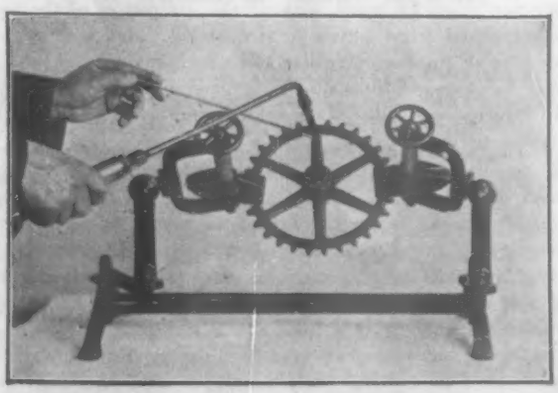
THE
GLOBE
WELDING VISE
PAYS FOR ITSELF IN TEN DAYS.



Price, $12.00

Saves blocking up work.
Saves turning out torch to turn work.
Work in sight to line up properly.

Each section of vise has five joints allowing vise jaws to swing to any position. All bearings ground and polished. Length of frame 24 in. Weight 20 lbs.

Write Dept. B for folder.

Manufactured By
ALBERT LEA FOUNDRY CO.
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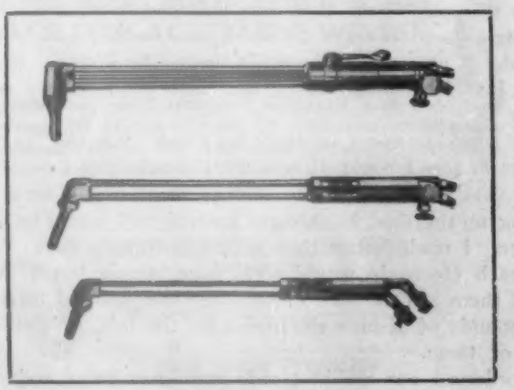

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Any Length Desired
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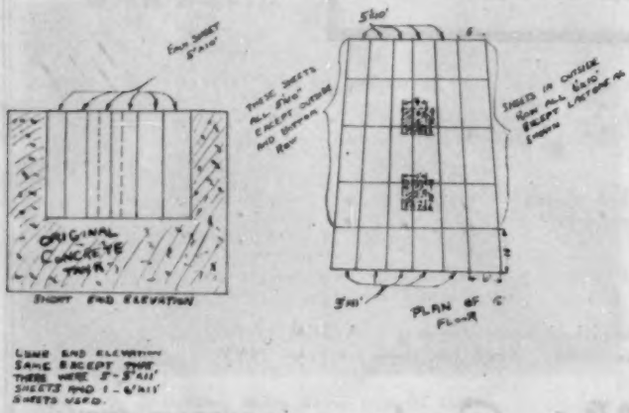
WELDED LINING FOR CONCRETE TANK

Editor:

Cattle like a change of pasture and the same applies to mankind. At least part of them anyway.

I have a new job. At present I am working for the "No Leaks" Tank Company which is located at Weldville in the state of Despair. But what I intend telling you concerns a certain tank I welded. Of course everyone makes mistakes, just seems they are unavoidable, but thanks to the welding process, they can sometimes be rectified.

A certain large manufacturing concern built a fuel oil tank a few years ago out of concrete. The sides or walls and bottom being four feet thick. The top was one foot and six inches thick. The inside measurements of this tank were



ten feet high, thirty feet wide and fifty feet long.

The company suffered quite a loss due to seepage, the concrete tank being porous. After some discussion, they decided to build a steel tank inside of the concrete tank. The "No Leak" was called to do the job.

The manhole in the tank was enlarged to allow a seventy-two inch sheet to enter. The electric welder was moved to the job. Current was supplied from the factory, the tank being just far enough from the factory for safety in case of fire.

The superintendent of the "No Leak" inquired as to the amount of feet I could do in a day. I told him I could make eighty feet per day, but he said as there would be a lot of welding up the side, he thought seventy feet would be a good average. I made better than eighty feet every day. We figured each electrode would weld four inches, but I guess I spread them out as they made five. We ordered three hundred pounds of ⅛-inch electrodes for the job. We still have some of them.

In ordering our welding rods we figured one rod out of eight was wasted by throwing away the end that remains in the holder and I believe the estimate is correct.

Thirty-two and three-quarter steel sheets, one-tenth by five by ten feet, were used for the sides, the extra three-quarters of each sheet was needed on account of giving each sheet about one-inch lap. For the bottom, five sheets, one-tenth by five by eleven feet, were placed along one way. A foot being divided for lap the short way of the tank. One sheet, one-tenth by six by eleven, was placed in the corner. One foot was allowed for lap, both the short and long way. Four sheets, six by ten, were placed along the long side, the rest of the bottom being covered with twenty sheets, five by ten.

Two concrete support posts, four feet by four feet by ten, were in the center. Eight sheets, four by ten, were placed around the posts, the sides and bottom being welded. Holes were cut in the bottom sheets to fit the posts.

The time required to do the job of welding was only about thirteen days, about twelve hundred and seventy-five feet of welding.

The sheets for the sides were raised in place, an angle iron was tacked to the bottom sheet, then placed against the side sheet and tacked until the sheet was welded.

After the tank was complete, it was tested by filling the space between the new steel tank and the old concrete tank with oil. I'll just let you guess how many leaks I had. They wouldn't average one to each day's welding. Of course there was little space between the sides of the tank and there was not enough oil to make much pressure. Possibly some of the leaks did not show.

The "No Leak" has an order for eight hundred discs one quarter inch thick, the diameter of same being eighteen inches. The superintendent just gave instructions to cut them out by the oxy-acetylene process. This is going to be some job. I'll either have to rig up some kind of a contraption to reduce the physical exertion or hunt another job. I'll tell you all about it later.

R. R. Palmer

JOHN A. ROEBLING'S SONS COMPANY ADOPTS GROUP LIFE INSURANCE

Announcement has just been made by the John A. Roebling's Sons Company, Trenton, N. J., to the effect that all employes, who have been with them a year or longer, on September 1, 1922, will be protected by group life insurance and pension plans. By arrangements made with the Equitable Life Assurance Society of the United States, the insurance will go into force automatically on midnight of August 31st.

The insurance is graded according to length of service, all employes more than one year and less than two years with the company to receive $500, increasing $100 each additional year of service until the maximum of $1,500 is reached for eleven years of service and over.

The insurance benefits will be payable to the beneficiary named by the employe, or, in the event of his becoming totally and permanently disabled before reaching age sixty, it will be paid to him.

The pension plan contemplates retirement at age sixty for males and fifty-five for females, and in the event that this class of employe has served twenty years or more, they may request a pension or be retired at the discretion of the company. Any employe, however, who has served thirty years or more, or any male employe fifty-five years of age and female employe fifty years of age whose term of service is twenty-five years or more, may at the discretion of the company be retired from active service and granted a pension.

The plan is further liberalized in that pensions may be allowable in cases of total disability arising from non-occupational injuries and illness, provided employ has served fifteen years or more.

The amount of pension is determined by multiplying one per cent of the average annual pay during the ten years preceding retirement by each year of service. A minimum of $25 per month and a maximum of $250 a month has been established and will apply, except in cases where the pension is being paid in cases of total disability above referred to, where the minimum may be less than $25 per month.

In working out this program the John A. Roebling's Sons Company are protecting their employes and their families, thereby relieving them of a certain amount of worry, and at the same time building up that friendly spirit of co-operation so essential for successful industrial life.

The Wilson Welder & Metals Co., Inc., New York, will exhibit and demonstrate the Wilson Welder at the Convention of the Association of the Iron and Steel Electrical Engineers at Cleveland, Ohio, September 11th to 15th. This exhibit will be located in booth No. 16 in the Cleveland Public Hall and Mr. J. B. Hendrickson of the Pittsburgh Office will represent the Company.

"Quality Protects Profits"

TORCHWELD

Reg. U. S. Pat. Off.

Non-Flash Apparatus

Unequaled

Records for Success and Size of Installations!

The high standing TORCHWELD enjoys in the iron, steel and metal working industries has been earned—only as such things can be earned—by giving downright good value!

TORCHWELD patented construction provides many advantages, invaluable to the welding and cutting of metals.

Equal Consumption of Oxygen to that of Acetylene for welding.

Equal Gas Pressures for Welding, and lower pressures than usual for cutting.

Freedom from flash-backs—regardless of the size of the welding or cutting job, — gases properly mixed *beyond* heat radius of the work.

Positive safety, whereby any attempted flame propagation into the welding or cutting torch is expelled.

Consider also that TORCHWELD welding torches are machined from solid bar brass stock, and that principal parts of the cutting torches are similarly made; all permanent joints are brazed. Heavy duty welding tips are machined from solid bar copper stock, and are sufficiently heavy to make them sturdy, long wearing, and free from seating troubles. TORCHWELD torches are as well balanced as the beam on a scale; they do not tire the operator.

A comparison of qualities and prices will reveal values you will eventually require and demand in torches, regulators, and general welding and cutting equipment.

Buy Torchweld Now!

Torchweld Equipment Company

Fulton and Carpenter Sts., Chicago, Ill.

"RACO"

MILD STEEL ELECTRODES for ELECTRIC WELDING

A general purpose wire, guaranteed to conform with the following specifications:

Penna. R. R.	Specification No. 156A
B. & O. R. R.	Specification No. 191D
C. P. R. R.	Specification No. 106
N. Y. N. H. & H. R. R.	Specification No. 161
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Also furnished dead soft annealed.

"RACO" COVERED ELECTRODES FOR ELECTRIC WELDING

"RACO" Covered Electrodes are used with either alternating or direct current where bare wires will not give satisfactory results.

"RACO" IRON ELECTRODES FOR ELECTRIC WELDING

This wire may be used with success wherever imported Norwegian or Swedish wire has been considered necessary.

"RACO" MILD STEEL RODS FOR OXY-ACETYLENE WELDING

Copper Coated

Answers the usual railroad, shipyard and industrial requirements as are allowed by authoritative regulating bodies such as the American Bureau of Shipping, the Interstate Commerce Commission, etc.

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Samples for testing and descriptive booklet sent promptly

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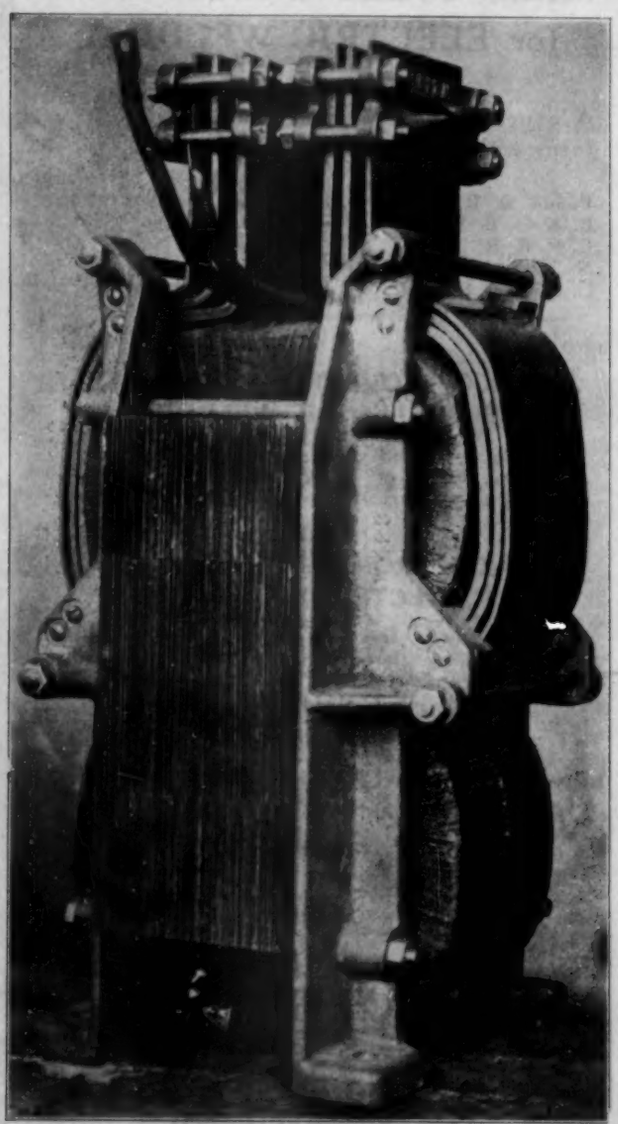
NEW RESISTANCE WELDING TRANSFORMER

The U. S. Electric Welder Company, 327-328 Permanent Building, Cleveland, Ohio, has placed on the market an electric heating and welding transformer of new improved design.

The illustration shows a 15 K. V. A. for horizontal mounting in a butt welder, or for heating purpose. It is, however, manufactured for vertical mounting and for other types of equipment in various sizes.



New U. S. Electric Welder Co., Resistance Welding Transformer.

The supports for primary and secondary coils as well as core are so designed as to prevent humming and shifting of all parts.

The secondary is built up of heavy rolled copper bends spaced for ventilating ducts, securely supported and insulated.

Extra large cooling surfaces insure that the temperature will be kept within safe limits during heavy overloads.

An internal automatic reactance prevents the current from reaching such limits that the temperature rises more than 50° C. above room temperature. The efficiency is, therefore, high—93 per cent in larger sizes.

LOWER TEMPERATURE RECOMMENDED FOR PREHEATING OF CAST IRON THERMIT WELDS THAN STEEL

In order to compensate for the lower melting point of cast iron as compared with steel, the Metal & Thermit Corporation, New York, recommends that in preheating cast iron sections, preparatory to thermit welding them, these sections be heated only a little more than necessary to show color, such as a dull red heat. If this advice is followed, a quieter heat will be obtained and the fusion will be just as perfect. This practice has now been tried successfully in numerous cases, the most important case being a thermit weld on a large cast iron press head which required 1,100 lbs. of thermit. The weld was absolutely perfect, with good fusion to the extreme of the edge of the collar, although the cast iron sections were heated only to a dull red heat.

It is believed that this point is very important to bear in mind and that operators will find that it will overcome possible difficulties which they may be experiencing in cast iron welding. One might suppose that as the cast iron of the parts being welded is not quite so fully expanded at this lower temperature there might, therefore, be a slightly greater tendency for hair line cracks to appear in the thermit steel collar perpendicular to the line of break. In actual practice, however, this has not been found to be the case, probably because of the fact that the expansion curve is much greater up to a red heat than it is from the red heat to the white heat and that the sections are, therefore, practically fully expanded at this dull red heat. It is certainly also true that the thermit steel at first heats and expands the sections with which it comes in contact and, therefore, the slight difference in preheating is negligible.

PRODUCTION BRAZING IN FABRICATION OF DENTAL EQUIPMENT

In the manufacture of dentists' chairs a certain manufacturer was unable to produce for use on the head-rest a solid joint so constructed that the ball would not work loose. This manufacturer fastened the ball to the pin of the head-rest by means of a rivet driven through a hole previously drilled through the ball and into the pin of the head-rest. He had previously tried soldering the two together. Neither method proved very satisfactory and chair parts were being returned from all parts of the world because of this seemingly slight defect which was, in fact, a serious one from the dentist's point of view. It was imperative that some means be found to correct this.

The manufacturer finally decided to try brasing the ball to the pin. This operation at first proved unsuccessful, but, being convinced that it promised the only possible solution of the difficulty, the manufacturer called in a sales engineer of the oxy-acetylene equipment manufacturer, whose apparatus he was using for other purposes. This engineer discovered that the manufacturer had been trying to braze a cast iron ball to a head bracket composed of cast steel. After explaining why this was impracticable he suggested that steel balls be used. Accordingly the steel balls were secured, and, after a few were brazed to the brackets, they were put into a vise and tested. The bracket was twisted out of shape without showing the least tendency to break the brazed connection. The superintendent then cut one of the joints and found that the skelter had penetrated to nearly two-thirds of the thickness of the ball and pin. The brazing operation requires only about a minute and a half for each joint, as compared to fifteen to thirty minutes to the joint formerly required when they were soldered.

MASTER BOILER MAKERS DISCUSS WELDING AT

The subject of welding was discussed at the annual meeting of the Master Boiler Makers' Association, held in the Hotel Sherman, Chicago, Wednesday, May 24th. Papers were read on the subjects "Oxy-Acetylene Welding" and "Electric Arc Welding."

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MANGANESE STEEL
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For Electric Welding — For Gas Welding

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Build Up a TRUE MANGANESE STEEL Wearing Surface with ROL-MAN RODS on Worn Manganese and Carbon, Crossings, Frogs, Switches and Track-work. Crusher parts, Dredge-Bucket Lips, Sprocket and Gear Teeth, Rolls, etc.

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Standard Sizes and Lengths—Coated or Bare — Samples on Request

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Help Wanted—75c per line, minimum 4 lines.
Jobs Wanted—4 lines free.
Other Ads—$1.00 per line, minimum 4 lines.
Counted 8 words to line. Add 6 words for keyed address.

Foreman Wanted—For large welding shop in Northwestern Pensylvania, operating both electric and gas welders. Also want layer-outs and fitters. Write stating age, experience and salary expected. Address 47, care The Welding Engineer.

Position Wanted—Arc welder having five years experience and ability to handle all classes of work either production or repair, wishes position. Address 43, care the Welding Engineer.

Business Opportunity—Responsible parties desire to hear from a good electric welder who has some capital to invest and desires to go into business. Excellent proposition and a good location. Address 44, care the Welding Engineer.

Position Wanted—Electric welder having 6 years experience on tank and pressure vessels, as well as repairs of all kinds, desires position. Address 45, care the Welding Engineer.

Position Wanted—Electric welder, 32 years of age, married, having five years' experience, desires position. Licensed locomotive marine steam boiler and general repair man. Has a fair knowledge of oxy-acetylene welding. Two and one-half years on last position, and able to furnish the best of reference. Location no preference. Address 46, care The Welding Engineer.

No. 10-A "FEDERAL" ELECTRIC BUTT WELDER; capacity 1¼" square solid steel; complete with three sets of dies, one being for round stock. This is a brand new machine.

No. 10-A-6 "THOMSON" ELECTRIC BUTT WELDER; capacity ¾" square solid steel; complete with one set of dies. This is a used machine, but in perfect shape.

Both in stock San Francisco, Cal.

PRICE—From $500 to $800 under regular price.

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SLOWS UP COOLING PROCESS
No obnoxious or injurious fumes.
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SOLDERING OF ALUMINUM, by J. A. Darby—If possible to repair or join aluminum parts by some other process than soldering, it is better to avoid the use of solder. If the parts must be soldered have the surfaces absolutely clean. Tin them in the regular way, use a good soldering flux and preferably a nickel soldering tool.—American Blacksmith, July.

ELECTRIC ARC WELDING IN COAL MINING, by E. Wanamaker—Three prime requisites for successful arc welding are proper equipment, and materials and requisite skill. Equipment must give heat application and heat control necessary and must be easily handled. Volt-ampere characteristic for arc welding circuits should facilitate rapid variation of current and voltage in response to variation of arc resistance. Skill is divided into engineering, supervisory and operating.—Coal Industry, June.

IMPROVED METHOD OF THERMIT WELDING RAIL JOINTS—Detailed description of the Thermit insert rail welding process with diagrams showing how the heat is supplied by the Thermit steel, and illustrations showing the appearance of the completed Thermit joints.—Autogene Metalbearbeitung, Dusseldrof, Germany, June.

TESTS ON WELDED CYLINDERS, by E. A. Fessenden and L. J. Bradford.—In order to compare the methods of constructing cylinders for handling anhydrous ammonia, four types of construction were tested, namely: Flange-steel shell, acetylene-welded longitudinal seam, concave heads forge welded to shell; seamless-pipe shell, convex head acetylene welded to shell; seamless-pipe shell, concave heads forge welded to shell; and flange-steel shell, acetylene-welded longitudinal seam, convex heads acetylene welded to shell. This paper describes the method of conducting the tests, presents the data obtained, and discusses the results.

The authors conclude that vessels having forge-welded heads are the least reliable and that burnt steel is often present in the weld. Also that the principal defects in acetylene welds are the course granular structure and the occasional porous spots and pinholes that develop with high pressures and the poor adhesion of the welding material to the original plate. Reasonable practical remedies for these defects are given.—Mechanical Engineering, September.

WELDING CAST IRON, by A. S. Kinsey.—Examination of the finished weld may reveal defects due to (a) use of too much flux (b) improper manipulation of the rod (c) improper flame adjustment (d) improper cooling. Description of the process of making an iron casting. Chemical nature of cast iron. Various grades of cast iron and their uses.—Railway Mechanical Engineer, September.

OXY-ACETYLENE WELDING RODS, by J. R. Dawson.—Function of the welding rod. General considerations in the selection of welding rods. Welding rod materials and their composition. Inspection and tests of rods. Physical tests of welds. Microscopic examination.—Industrial Gases, London, June.

USING THE FORGE AS A PREHEATER IN GAS WELDING, by David Baxter.—How the country blacksmith can handle a number of the simpler welding jobs by using the regular blacksmith shop equipment to supplement the torch.—American Blacksmith, August.

CONTRACTION IN TUBE WELDING, by Marcel Piette.—Methods of avoiding the contraction effects by preparing the parts so that the welding operation draws them in to the desired shape.—Acetylene Journal, September.

A LITTLE METALLOGRAPHY.—Setting up the apparatus for taking microphotographs of metals, with specimens to indicate what conclusions may be drawn from them.—Revue de la Sondure Autogene, Paris, July-August.

THE PRESERVATION OF ACETYLENE APPARATUS, by D. Richardson.—The selection of paints, varnishes and protective coatings for exterior and universal parts of acetylene apparatus, parts in contact with moist and impure gas, interior of purifying vessels, carbide trays, etc.—Acetylene and Welding Journal, London, August.

In a paper on Turbine Gearing, read before the Liverpool Engineering Society, S. B. Freeman explains that there have been attempts to harden the materials from which gears are cut. Grinding to correct deformations caused in hardening is the penalty. Since helical wheels cannot conveniently be ground, the straight spur tooth must be adopted. Large wheels cannot be ground at all by reason of technical difficulties. Methods of hardening the teeth locally by oxyacetylene or electric arc heating and rapid quenching are also being tried. The most common defects so far experienced in forged steel have been inadequate heat treatment and slag inclusions.—*The Engineer.*

The Annual Convention of the International Acetylene Association will be held this year at Chicago, October 25th, 26th, and 27th. It is expected that complete details will be ready for publication in the next issue.

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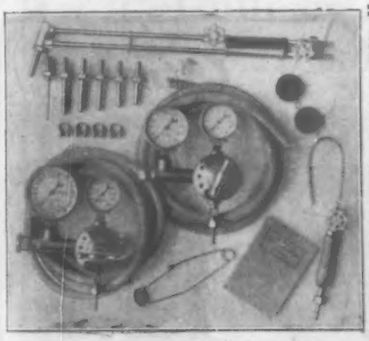

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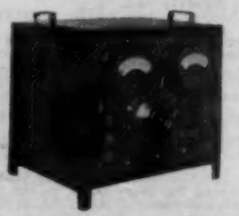

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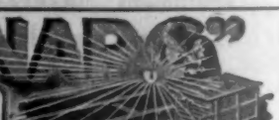

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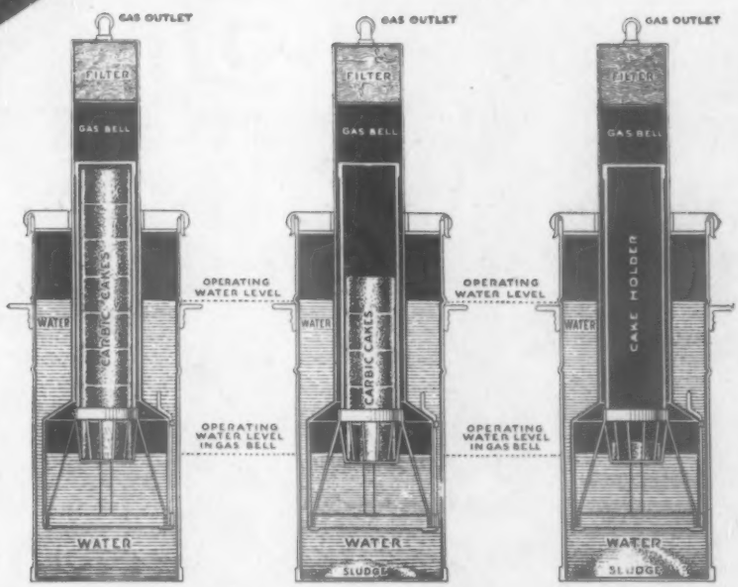

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